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Index to Advertisers and Classified Index Following Reading Matter.

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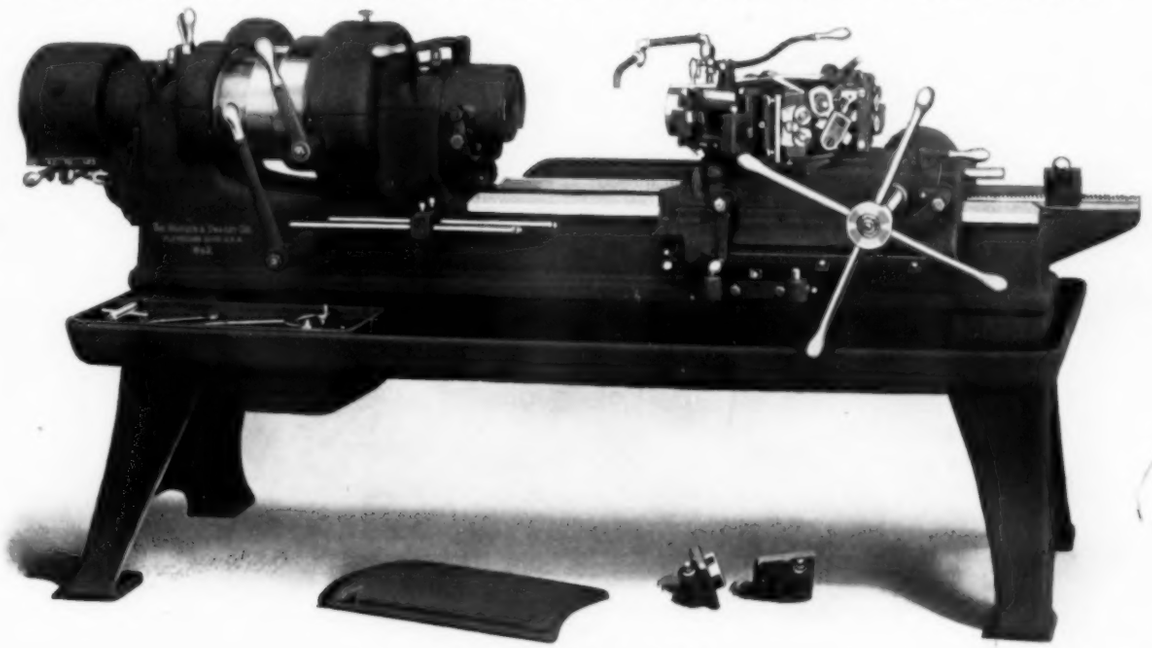

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Turning Turret Tracks for Battle Ships

A Portable Machine That Faces the Tracks and Track Liners in the Shop and on Board the Ship Itself

EDITORIAL CORRESPONDENCE

We are very apt to think of a battleship as a whole and overlook some of the separate parts and the operations necessary to produce them. The guns have recently received careful attention but such work as the machining of the tracks on which the turret is turned is a detail that would hardly be thought of. Yet unless the tracks are true and allow the turret to be handled readily, the efficiency of the guns is much impaired.

There are few boring mills in the country which can handle work of this size and as none of the navy yards have them, it was necessary to devise a machine for this work. After carefully considering all sides of the question, it was decided to make a machine of the portable type in order to rough turn the turret tracks on the shop floor and afterward finish them in place on the ship; the same operations being necessary on the bottom of the turrets themselves.

An idea of the size of the machine shown in Fig. 1 can be had by noting that it is at work on a turret track for the monitor "Wyoming" and is over 22 feet outside diameter. The track is a little over 6 inches deep and the stiffening ribs are about 24 inches apart. The face of the track is 14 inches wide. The tracks for battleship turrets are similar in size as their monitor carries two 12-inch guns.

There are 40 rollers under the turret, 10 inches in diameter at the outer end and 8.947 inches at the other. These are made of forged nickel steel and the "A" or highest degree of accuracy is specified.

Large cast-iron floor plates are used for the machine itself and the ring is blocked up as shown for the roughing cut, about ⅛ inch being left for finishing in place on the ship.

The tracks are in six equal segments, all bolts are of nickel steel and body bound and three wedges are fitted in the lower track for removing rollers.

The liners and tracks are then assembled on board ship and the machine set up over the barbette, where the finishing cut is taken in place.

The track on the bottom of the turret is faced by turning the machine upside down under it and operating in the same manner as for the lower track.

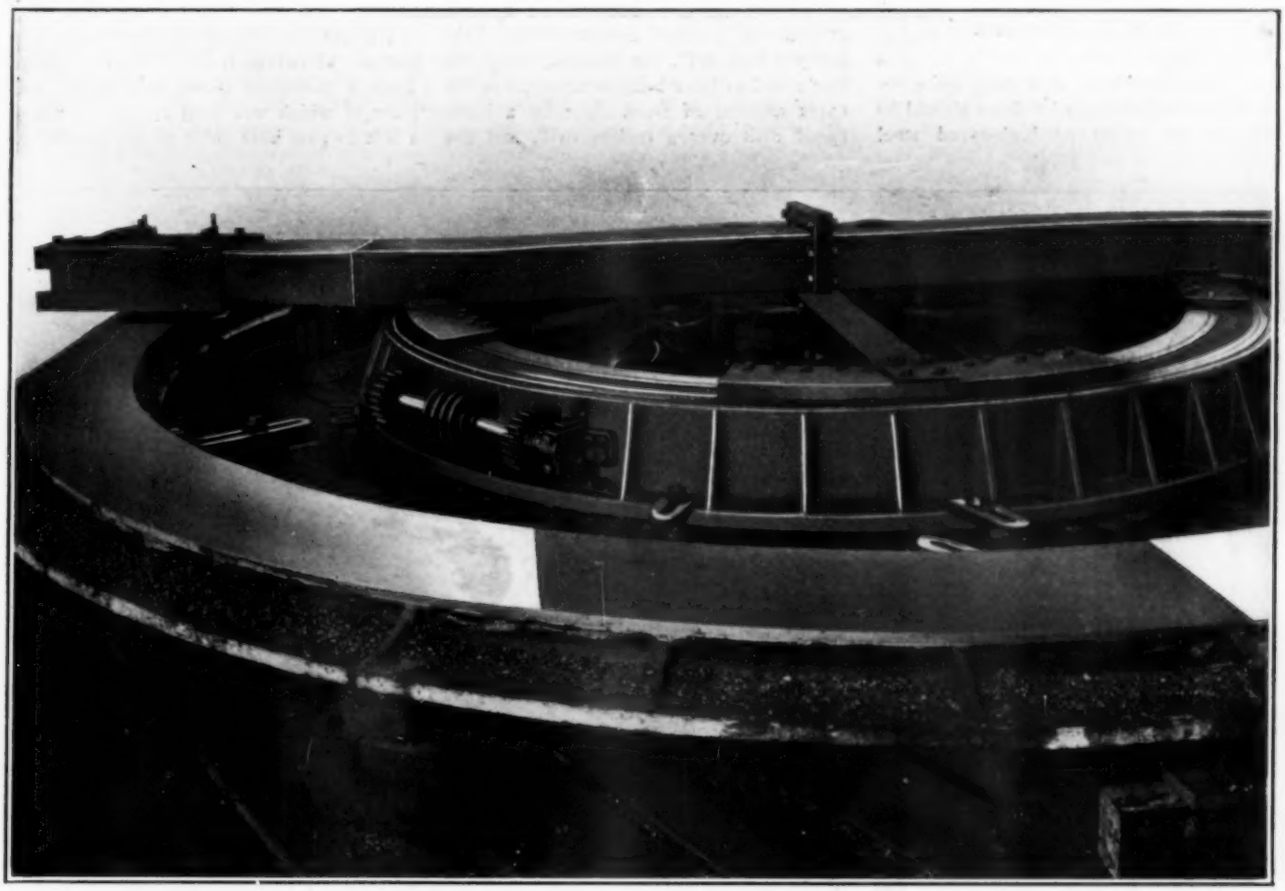


FIG. 1. SHOWING CONSTRUCTION OF SUPPORT AND DRIVING MECHANISM

The details of the machine itself are shown in both Figs. 1 and 2. It consists of a heavy cast ring, ribbed on the outside and faced on top for carrying the shoes on the ends of the bars. It is bored on the inside for the ring which carries these shoes and which has a worm wheel attached to it, under the sliding surface. The dark ring shows the bearing of the shoes on the top of the ring.

The worm shown at the left of the ring and under one of the shoes, drives the worm wheel and the cutting tools, the

power being taken from the motor shown on the inside of the ring. This drives a shaft inside the ring, by chain belting and the inner shaft carries pinions which drive the gears shown each side of the worm.

The tools are carried in holders at the end of the bar, each holder having a cross feed by means of the star wheel which is shown on the outer end of the feed screw. The angle of the tool-block slide can evidently be adjusted to give the degree required for any diameter of turret.

How a Believer in High-speed Steel Drills Avoids Loss in Hardening

By M. H. Westbrook

I have never been able until quite recently to understand why there should be between the prices of high-speed steel twist drills and of the ordinary carbon-steel drills a difference greater than that existing between the prices of the steels themselves, for, having made a large number for our own use, I could make one kind just as cheaply as the other. Upon inquiring of a representative of one of the high-speed drillmakers, he informed me that it was owing to the large number that were lost in the hardening process. Now if there is a greater loss there, this would certainly account for it; but in my experience in hardening them I have found no loss whatever, only I have found them liable to break off near the end of the flute quite often. It is of this that I particularly desire to speak. Since so many were breaking off, as mentioned above, I have hardened them only 2 inches from the point, and as each 2 inches wears off I reharden them. This does not appear to cause the steel to deteriorate at all, and I have not had one break off since adopting this method. Of course, I fully realize that the manufacturer could not very well send them out hardened in this manner, but as long as the price remains so high many users will continue to do as I am doing, make them themselves; and it is these people whom I wish to address.

High-speed Steel Drills A Profitable Investment

I wish to add that, despite the high price of these drills, from a real business standpoint, using drills for ordinary heavy work "not cored," one could not afford to use carbon-steel twist drills even if he were supplied with them free. I have proved this by actual demonstration. Taking a 1-inch drill, for instance, after the first 2 inches have become worn away the extra amount of work done by a high-speed drill over a carbon drill, and the wages saved, will give you the remainder of the drill for nothing.

Just an instance of results obtained without any special effort or urging from me. I saw one of the drill men, who, by the way, works day work, drill 4 locomotive cylinder covers each having fifteen holes 1⅛ inches diameter, 1¼ inches deep, in 30 minutes. The actual time taken to drill the holes, as determined by timing five or six, was 12 seconds per hole; the rest of the time was taken up in placing the jig and shifting the radial arm of the machine, which was an old Pond drill press that had been in continual service for 22 years. The speed of the drill was 90 feet per minute, and it was in fairly good condition when the work was completed.

Emergency Roll-grooving Rig

By J. W. Frescher

I had a job to do recently that for a time was a puzzle. There was a pair of washer rolls to be made and each was to have 250 spiral grooves, 4-inch lead, running almost parallel with the face of the roll. The rolls were 12 inches in diamter, 36-inch face, with journals 8 inches in diameter and 10 inches long. We did not possess a milling machine heavy enough for a roll of this size, so decided to plane the spiral grooves. We could not afford to go to any great expense for a fixture to do this job, as it was not at all likely that we should ever have another like it.

We put the roll on the centers of the planer, allowing it to revolve freely. Then a two-piece clamp was made, one piece of which was long enough to allow a bolt to pass both sides of the journal of the roll and the other piece long enough to extend 1 foot over the side of the bed of the planer. We then took a piece of 1¼-inch cold-rolled shafting 8 feet long, forged a flat on both ends 4 inches long, drilled two ¾-inch holes in each end and bent the ends to such an angle that we could bolt one end to the housing of the planer and lag the other end to the floor. The end fastened to the housing was about 5 feet from the floor, and, after figuring out the angle, the other end was blocked to about 10 inches above the floor and fastened securely in that position.

A weight was then attached to the long end of the clamp and the clamp allowed to ride up and down on the 1¼-inch shaft. As the platen of the planer traveled forward and backward, the clamp turned the

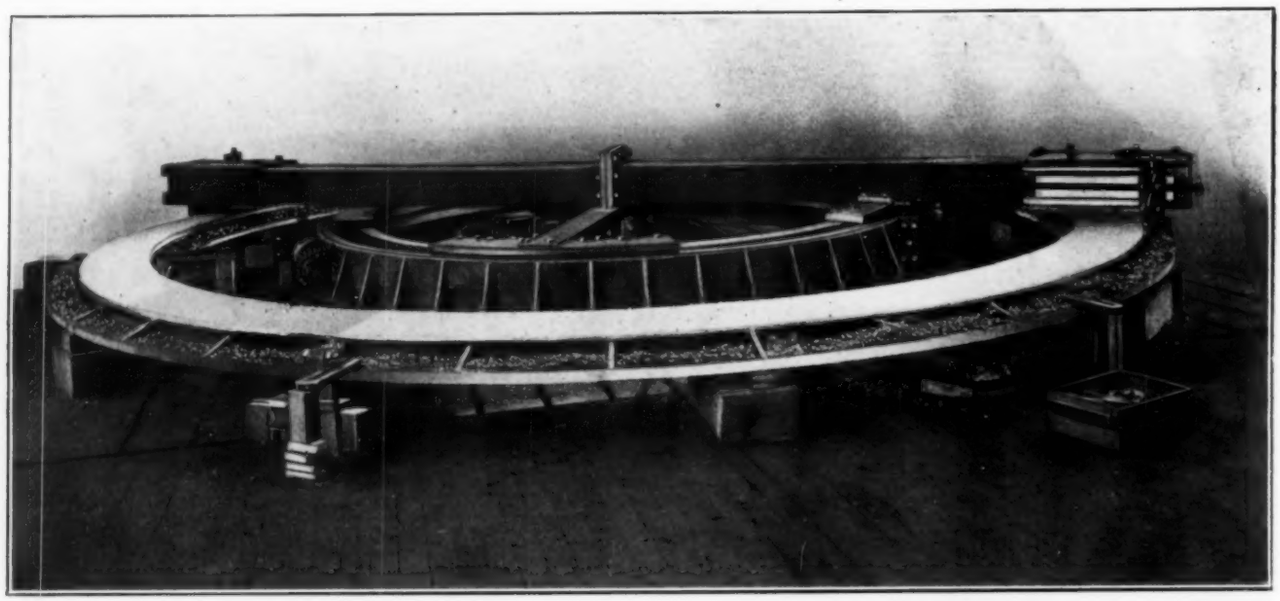


FIG. 2. FACING THE TRACK FOR TURRET OF MONITOR "WYOMING"

roll sufficiently to produce the desired spiral cut. Of course after each groove was planed the desired depth it was necessary to loosen the clamp and turn the roll for the next groove.

A 14-inch Wire-wound Gun

By Grahame Powell

The contest between gun and armor plate for supremacy has been a long-drawn-out and fluctuating one, success remaining for a time with the one only to be shortly wrested from it by the other, though victory has seemed to remain for longer periods with the armor-plate, and this led to what has to all intents amounted to a craze to increase the velocity of the projectile, with a consequent increase in energy of blow delivered.

Twelve years ago a muzzle velocity of from 1700 to 1800 feet per second was deemed ample; but improved armor plate demanded an increase in energy if it was to be overcome, and with improved smokeless and slow-burning powders projectile velocities of 3600 feet, and more were gradually attained, and the armor plate again succumbed to the onslaught. And here the case might have rested, with victory perched on the banner of the gun. But, unfortunately, this enormous velocity was not obtained without cost, and recent experience has demonstrated that the cost is too great a burden to be borne. And what was this cost? Erosion. It was very soon discovered that one result of the enormous charges of smokeless powder required to give such high velocities was a rapid and destructive wearing away, or erosion, of the bore of the gun, an erosion that resulted in reducing the life of the gun from 250 or 300 rounds to 60 or less.

The cause or causes of this erosion are still a mystery, there being nearly as many explanations as there have been ordnance engineers who have attempted to account for it. The erosion, however, was self-evident, and practically the only thing known was that with smaller charges and less velocities, the wearing away did not occur.

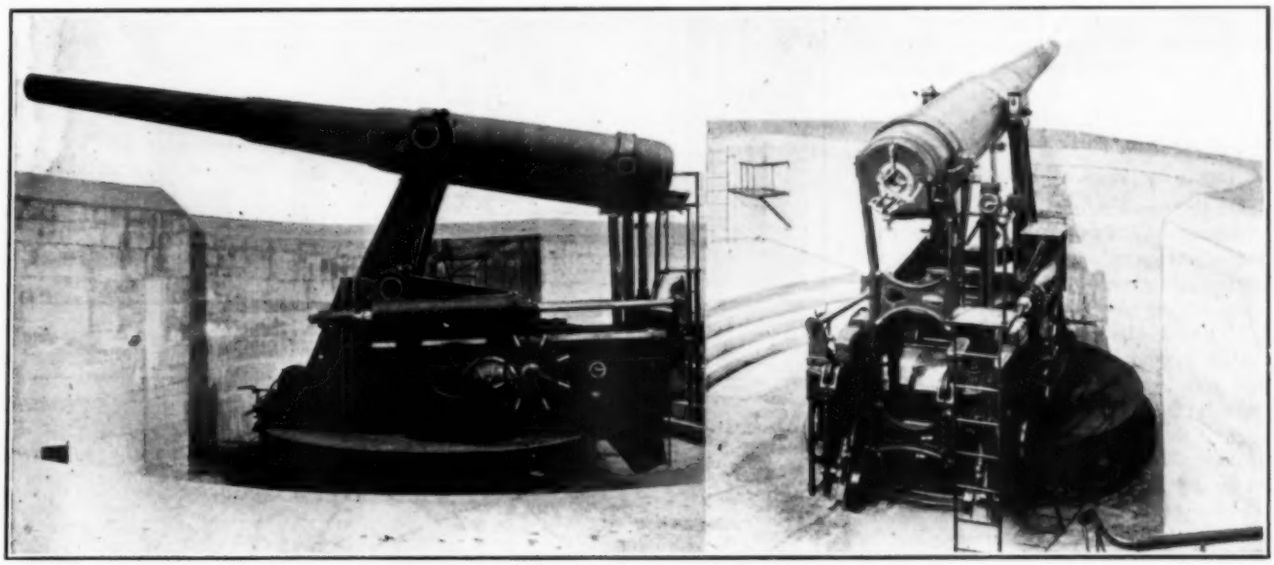
Fifteen Hundred Dollars a Shot

The 12-inch army breech-loading rifle of 1901 is a nickel steel gun, designed for a muzzle velocity of 2550 feet per second, and costing in the neighborhood of $61,000, and when constructed was expected to be capable of firing about 250 rounds with full charges before it became worn out. Tests, however, on the proving ground demonstrated that its life would not exceed sixty rounds. Something had to be done. Even the modern gun designer with his almost utter disregard of cost, was compelled to pause when he contemplated the expense. Here was a gun costing $60,000 to build, and in the neighborhood of $500 for a single round, good for but sixty rounds—$1500 a shot. And yet, the armor plate must not be allowed to remain victorious.

The National Coast Defense Board, in its report to Congress, a year ago, discussed the question at some length, and said that the demand for heavier armament and better protection has led to a marked increase in the tonnage of battleships. Battleships of 18,000 tons and upward, mounting twelve to fourteen 12-inch guns, with a great increase in armor protection, have been built. Land guns must keep pace with such advance.

The Latest Coast-defense Guns

Our latest 12-inch coast-defense gun has an initial velocity of 2550 feet per second and a muzzle energy of 47,299 foot-tons. With this energy the 12-inch armor of the latest type of battleship can be penetrated with normal impact at 8700 yards, and the 7-inch at all fighting ranges. But in developing this energy the high temperatures due to smokeless powder and the great increase in the volume of gas produce an erosion which materially shortens the life of the gun. There is little to warrant the hope that any material improvement will be speedily effected in the manufacture of either steel for gun construction or in powder to overcome this erosion. It is considered unwise to tax the 12-inch gun to such an extent as the high velocity entails for the protection of the wide channels that exist at the entrances to Long Island Sound, Chesapeake Bay, Puget Sound, and Manila, if by increasing the caliber of the gun an equal or greater fire effect can be secured by employing a diminished velocity which will not sensibly impair the life of the gun. Such an increase in the caliber means a large increase in weight of gun and carriage, a consideration of little moment in land defense, but prohibitive for use on battleships.



THE WAY IN WHICH THE 14-INCH WIRE-WOUND GUN WILL BE MOUNTED

The 12-inch gun can now fire two aimed shots in less than a minute, manual labor being used for loading and operating the gun and carriage. It is believed that this rate will not be materially diminished if the 14-inch gun mounted on a disappearing carriage of the same type as that now employed for the 12-inch gun, loaded and operated by the same means, be adopted. For the 16-inch gun, however, mechanical devices must be resorted to for loading and operating, a very decided disadvantage. The cost of the 14-inch gun with the required energy, is but slightly in excess of the cost of the 12-inch gun with an equal energy at 8700 yards. For these reasons the board recommends the adoption of 14-inch guns mounted on disappearing carriages for the defense of the

channels above enumerated. The 14-inch projectile will carry a bursting charge of high explosive more than 50 per cent. in excess of the charge, of the 12-inch projectile.

Fourteen-inch Guns Recommended

The approved projects of the National Coast Defense Board call for twenty-seven 14-inch guns for fortifications in this country and the insular possessions.

The board said "such an increase in the caliber means a large increase in weight of gun and carriage." The only gun in the mind of the board was a built-up gun similar in all respects to the 12-inch guns in service, except for the increased caliber.

Very recently, however, the feasibility of a wire-wound 14-inch gun has been suggested. The wire-wound system of gun construction has been extensively used in England for all calibers, but only a very few, and these test guns, have been manufactured in the United States, the largest being 10 inches. The 10-inch wire gun designed by Gen. William Crozier, now chief of ordnance, was fired up to 275 rounds as long ago as 1896, and since then a gun of the same caliber of the design of J. H. Brown, has been under test, having been fired 25 rounds in all, but the test has been interrupted more than once by various accidents, none of them, however, it is but just to say, due to the wire portion of the system.

Details of the Wire-wound Gun

On the recommendation of the board of ordnance and fortification, approved by the secretary of war, the ordnance department has now decided to construct a 14-inch gun on the wire-wound system. This gun will be 40.5 feet in length and will weigh 109,500 pounds; weight of projectile 1660 pounds; powder charge, 280 pounds; muzzle velocity 2150 feet per second, with a maximum pressure of 36,000 pounds per square inch, and a muzzle energy of 52,324 foot-tons. The weight of a 14-inch built-up gun would be 120,500 pounds, the other elements remaining the same. It consists of an inner tube carrying the rifling, about which is wrapped the square-drawn steel wire, and this in turn is covered by a hoop or casing, which serves to protect the wire from mechanical injury.

The merits claimed for the projected gun are simplicity and cheapness of construction, and superiority of reserve strength, the lower cost being due to the difference in price between steel wire and gun steel. The design was made by General Crozier, the patentable features therein having been generously thrown open by him to public use in 1903.

This gun is of no greater trunnion diameter than the high-powered 12-inch gun, and will be mounted on the disappearing carriage designed for that gun, thus nullifying the prediction made only a year ago by the National Coast Defense Board of increase in weight of carriage.

The Wilson Registry System

By A. H. Chase

The methods of accounting for the arrival of employees before starting time in large manufacturing plants has always been a more or less troublesome question, and various devices have been used for this purpose. These range from the simple system of the foreman checking the presence of his men at starting time to the most elaborate time-clock system. The Wilson Registry System is designed to meet the needs of any establishment, large or small, and, from a practical use of several months, appears to fulfil its purpose.

The general appearance of the boards and tags as used in this system is shown in Figs. 1, 2 and 3, Fig. 1 being before registering, Fig. 2 after registering, and Fig. 3 the board closed. A detail of the tags and of the strips upon which the tags are mounted is shown in Fig. 4.

The tags are made of any suitable sheet metal, with buttons riveted in the top as shown in the sketch. The strips upon which the tags are mounted are also made of sheet metal, the tags being hung in the V-shaped slot, the neck of the tag button sliding freely in the slot. The strips are flanged on one edge and have projections raised between the slots; these are to prevent each tag from interfering with its neighbor. Back of each slot a strip of spring brass is soldered for holding the tag in place. The tags are inserted by snapping the tag button through the enlarged portion of the slot. Hole *A* is for pressing the spring away with a lead pencil or any other convenient article for removing the tags from the strips. At *B* is a countersunk hole in the spring central with the enlarged portion of the slot, and *C* a tit in the center of the tag button. These are for centering the tag button with the enlarged portion of the slot, thus facilitating the removal of the tag.

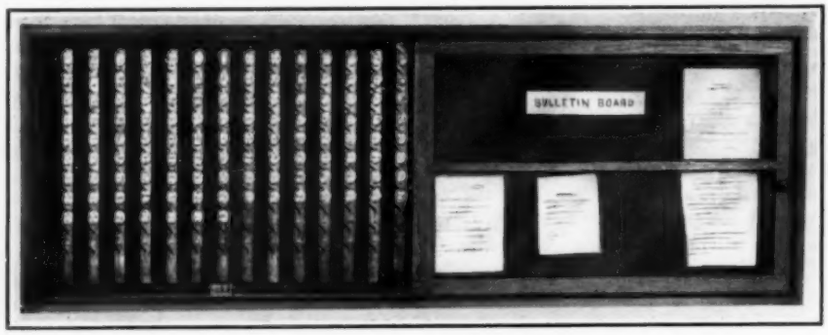


FIG. 1. BOARD READY FOR REGISTERING

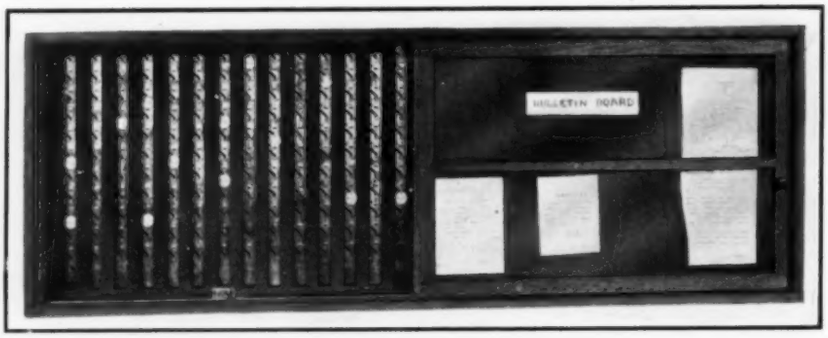


FIG. 2. BOARD AFTER REGISTERING—SHOWING ABSENTEES

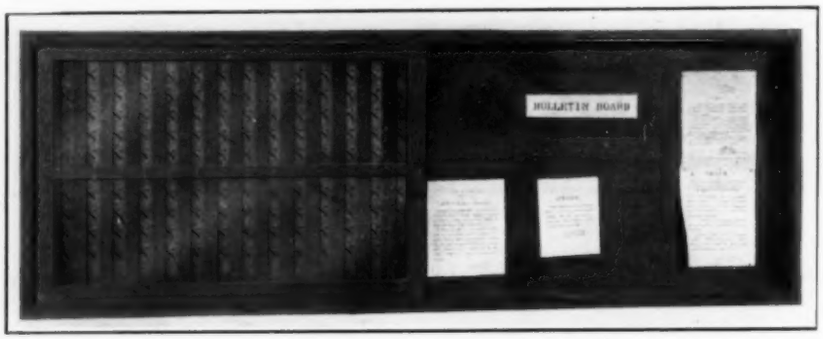


FIG. 3. BOARD CLOSED WHEN NOT IN USE

The strips are mounted vertically in any suitable wooden frame, and in front of the tags is mounted a sliding shutter built up of galvanized iron. This is arranged to slide in the frame so as to cover or uncover each end of the V-shaped slot, and thus the tags in these slots. This shutter is arranged to be locked in either position. In front of this is a sliding glass door for closing the entire board.

In use, the board is kept closed, as in Fig. 3, except that the glass door should cover the tags. The board was photographed with this door open so as to show the tags more clearly. When the time for registering arrives, the board is

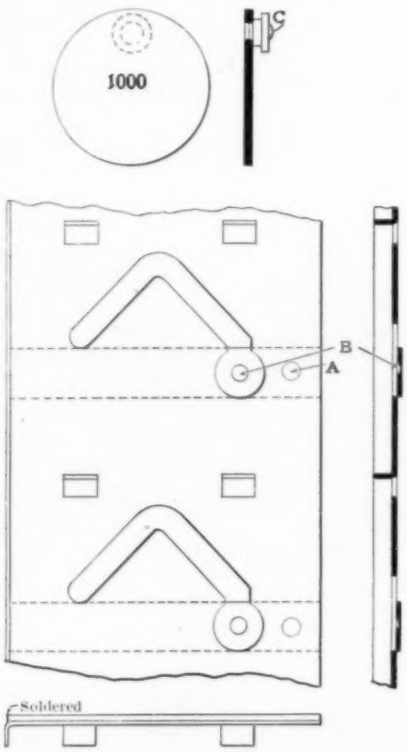


FIG. 4. THE CHECKS AND THE SLOTS

opened and the shutter slid to uncover all the tags. In registering, the workman pushes his tag in the slot so that it falls behind the shutter. At starting time the glass door is closed and the exposed tags show what workmen are absent. The blank half of the board is used as a shop bulletin board.

This system is now in use at the naval gun factory, Washington navy yard, and was devised by Master Mechanic Wilson, of that place. A muster board (so called) is installed in each shop so that the men can register upon entering the shop in which they work. The tags, strips and shutter are easily distinguishable, the strips being copper, tags aluminum with black figures, and the shutter galvanized iron painted black. The system appears to answer every requirement of this large plant, having minimized the troubles incident to the tag system it replaced.

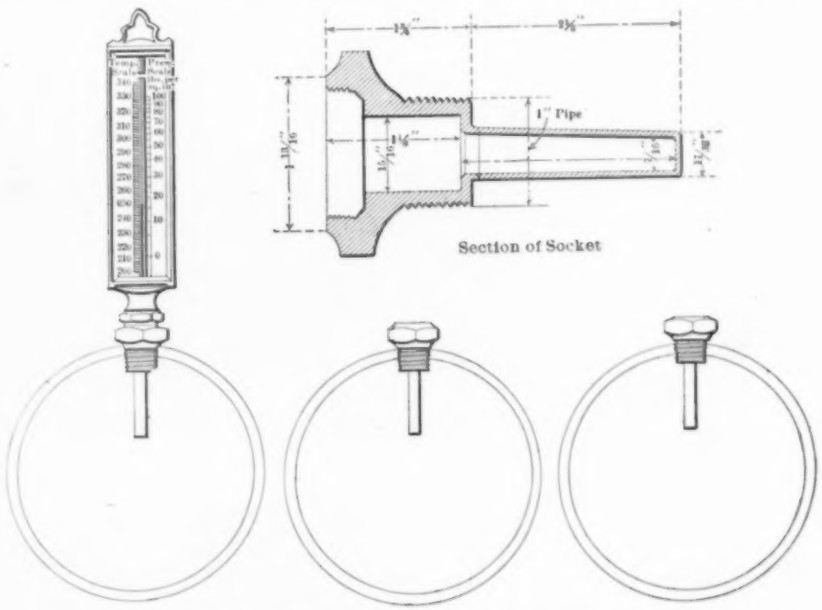
Thermometers with Separate Sockets

By F. E. Armstrong

This style of thermometer is designed to be used with sockets, which may be made a permanent attachment in the place where it is desirous of knowing the temperature. One thermometer may be used with any number of sockets, as they are all made interchangeable.

In some places it is desirable to know the temperature where the thermometer would be under pressure. In such a case a socket is desirable as the thermometer to go with it can be removed and used in other places, while the ordinary thread connection thermometer could not be removed while the pressure was on.

The illustration shows a series of tanks with sockets attached, the temperature in



SEPARATE SOCKETS FOR USING ONE THERMOMETER IN DIFFERENT PIPES OR VESSELS

which may be found by simply inserting the one thermometer in the several sockets, also a detailed section of one of the sockets.

How the Sockets Are Made

These sockets are made of both composition and steel. They are bored and tapped in a Cleveland Automatic machine, then the smaller hole in stem is drilled in the drill press. After drilling we use a turret jig and ream with taper reamer in the drill press. The turret on this jig revolves in a vertical plane and has five bushings for sockets.

We ream nearly to the bottom of a socket, then turn jig to next station and repeat the operation. During the reaming of the second socket, a tube connected with the oil pump of the drill press is inserted into the first socket and the chips are all washed out. Repeat until the five sockets are partly reamed. Then the reamer takes the final cut and goes close to the bottom of socket.

Hand Reamed and Ground

After machine reaming the sockets go to the lathe and stems are turned, after which the 1-inch pipe thread is cut in the automatics and then are hand reamed to gage. In reaming, great care is taken to have as perfect a bearing as possible on the taper plug gage and all are reamed so that the gage will go in a certain depth.

The chamber on the thermometer which fits in the socket is made of steel and is ground on a Brown & Sharpe grinder to fit accurately the taper hole in the socket.

This steel chamber contains the glass bulb of the thermometer which is surrounded by mercury which completely fills the space in the chamber.

By this arrangement there is complete metallic contact between the glass bulb of the thermometer and the wall of the socket which is exposed to the heat, thus giving a quick transfer of heat from socket to thermometer and a quick reading on the scale.

Yarn, with powdered stone can cut a steel bar. Major McClaughry, warden of the Federal prison at Fort Leavenworth, once found a prisoner working away at one of the bars to an outside window. A grating of the same description was placed in his cell and a guard stationed over him to watch the cutting process. With the limestone dust and silicate from the stone pile, the yarn from his sock and a little water the man cut the bessemer steel bar in 18 working hours. With some fine emery, a chalk line and two wooden handholds to save his fingers he made a clean cut of the other bessemer bar in 5 hours.—*Stone.*

The Rudge-Whitworth Cycle Works

Where an Output of a Thousand Cycles a Day Indicates that Wheeling Is Not Altogether a Thing of the Past

BY I. W. CHUBB

Coventry, the Warwickshire City of the Spires, stands at present in risk rather of being known as the City of the Open-hand, this being the trade-mark which dominates the surroundings from the central tower of the Rudge-Whitworth works. Through its components the firm dates back 30 years, but the chief expansion in the business has occurred since 1894, when the Whitworth and Rudge cycle companies amalgamated. Rudge-Whitworth, Ltd., is now generally recognized as decidedly among the most progressive firms in the cycle-manufacturing industry of Great Britain. Their guarantee of all metal parts of a bicycle for 10 years may be a surprise to some.

The heavier operations of this comparatively light business are mostly done at the Birmingham works, some 18 miles away, the parts being delivered to the Coventry works for assembling. The latter are in two main buildings, the newer of which, completed at the end of last year, forms the principal subject of this article. This new building is 400 feet long by 60 feet by 83 feet from basement floor to roof. The six floors therefore have a combined area of 144,000 square feet.

A Very Light Shop

The window area is unusually large, there being no less than 36,000 square feet, or 1 square foot of glass area to every 4 square feet of floor. The panes are large, of wired glass, and protected from the sun by blinds. Both arc lamps and the Keith-Blackman system of gas lighting are employed. In the works are 60 telephone stations, while the firm has a private trunk line to Birmingham and eight outside lines. The works are electrically driven throughout from the municipal mains, which supply two-phase current at 2000 volts, transformed down to 200 volts. The new building contains some 50 motors totaling about 750 kilowatts, the sizes ranging from 2/3 horse-power upward.

The Coventry works employ about 1700 people, generally on piecework, the number rising to 2000 in the busy season. Apprentices are not taken, but boys are trained up from the simpler operations until at the end of 5 or 6 years they are fully qualified for the firm's purpose. Necessarily a number of women and girls are employed in press work and in fact throughout the building.

The main enameling floor reached on the first landing from the top, is laid out on the basis of the production of 1000 cycles a day of 10 hours, this being maintained throughout the whole of the building.

An Interesting Machine

In the rolling department the Pugh patent machine runs the metal off coils, each of which will make about 50 rims. The strip goes through the rolls, as described below, and is then circled to the correct diameter of the tire once for all, and cut off while in motion. Everything is in sight at the correct hight for the operator, who keeps the machine fed and removes the rims as formed. The machine would run by itself, the operator merely bringing to it fresh coils of steel, which weigh each about 80 pounds; but as the material varies slightly it is desirable therefore that the man should always be at the machine, gaging the curvature of the rims and adjusting accordingly. The rims being formed, girls punch the spoke holes in them, all to templet. A special plant is used for rolling tubes for the curved frame of ladies' machines.

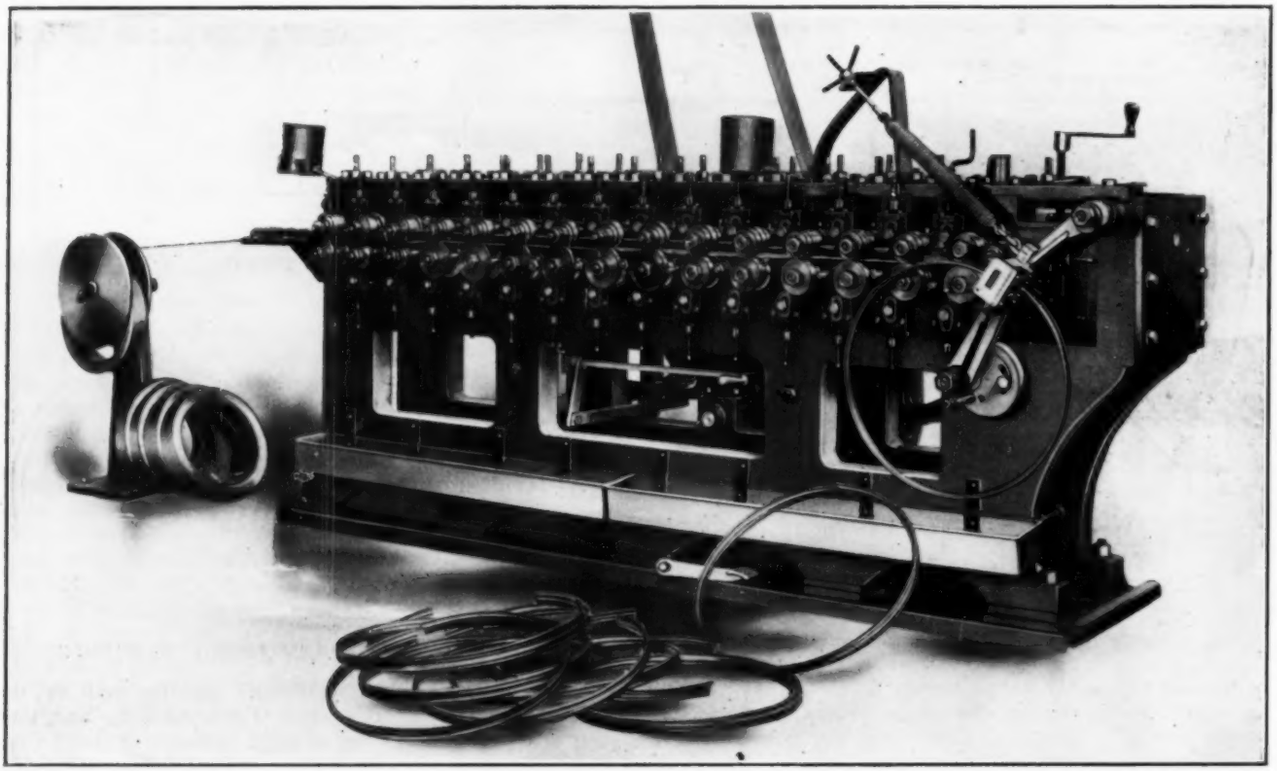


FIG. 1. PUGH 15-ROLL MACHINE CUTTING OFF A RIM

The 15-roll mill for forming the strip into a suitable rim section and bending it to a circle is shown in its latest form in Fig. 1. The special feature is that the complete rim is cut off without stopping the machine, the illustration showing it in the act of cutting off. A side view of one of the several forms of shearing device is given in Fig. 2, with details in Fig. 3. An arm *A*, concentric with the curved rim, bears a box *B*, which carries a front guide having an opening *C* Fig. 3, through which the rim passes. At the back of this guide is the shearing tool *D*, which receives a radial motion in the box. However, when this tool is not in operation an eye formed in it comes in line with the similar eye in the front plate, the proper relative position being secured by helical springs shown in Fig. 2. Behind the shearing tool and secured by a small bracket *E* is a helical guide strip for the rim. A second guide *F* is similarly held in front of a second opening in the box end, Fig. 3; this carries a stop which is in a plane in front of that of the shearing tool. A helix of single turn can thus be formed. The back guide plate carrying the stop is supported by a rod pivoted eccentrically with regard to the main arm. As this is turned the back guide is raised in its recess and the stop is raised out of the path of the rim. Bearing on the shearing tool is a movable finger *G*, which with the turning of the main arm, forces down the tool and carries its eye below the opening in the front guide. Thus the rim material may be fed over the front guide and through the shearing tool, passing over the helical guide strips and butting against the stop of the back guide. In this way the feeding motion of the machine turns the main arm. The shearing tool is then forced down by the finger, and the ring, or rather helix, of metal formed is cut from the main portion, the finger escaping as soon as its action is completed. The tool then returns to its normal position under the action of the springs. With the motion of the arm the back guide is raised until the material ceases to bear on the stop. The arm is then returned to its normal position by means of the spring, while the stop is returned simultaneously in the same way. It will, of course, be understood that the shearing tools are designed according to the section of the rim.

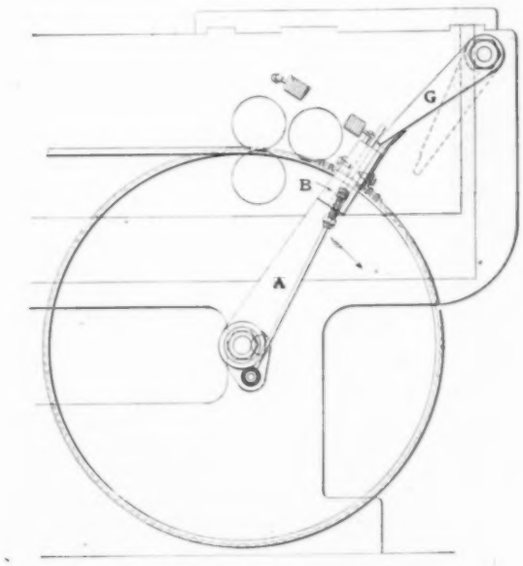


FIG 2. ENLARGED VIEW OF CUTTING-OFF DEVICE

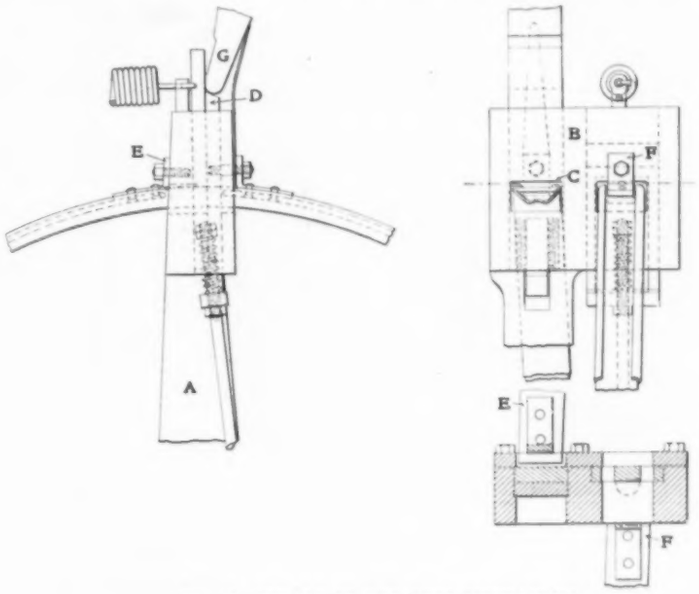


FIG. 3. DETAILS OF SHEARING MECHANISM

Assembling the Wheels

For each wheel a girl is given a rim, a hub, 40 spokes and a packet of nipples. She then builds up the wheel as described by V. A. Holroyd, the works manager, as "something between knitting and bird-cage making." The wheel then passes to a skilled male worker, who trues it on centers in the usual way with the aid of chalk, the wheel, while being set by means of the spoke nipples, being regarded as a chuck with 40 adjusting screws. Wheels of every kind are made here, from those with wooden racing rims to motor wheels for 100-horse-power racing cars. The lightest rim for a detachable tire, however, is of aluminum, weight 1 pound 3 ounces. It is rolled to shape in the machine used for steel strip, but, owing to the fragile nature of aluminum, must be cut off separately, not by the automatic action of the machine as for steel rims. For the aluminum, and steel also, a

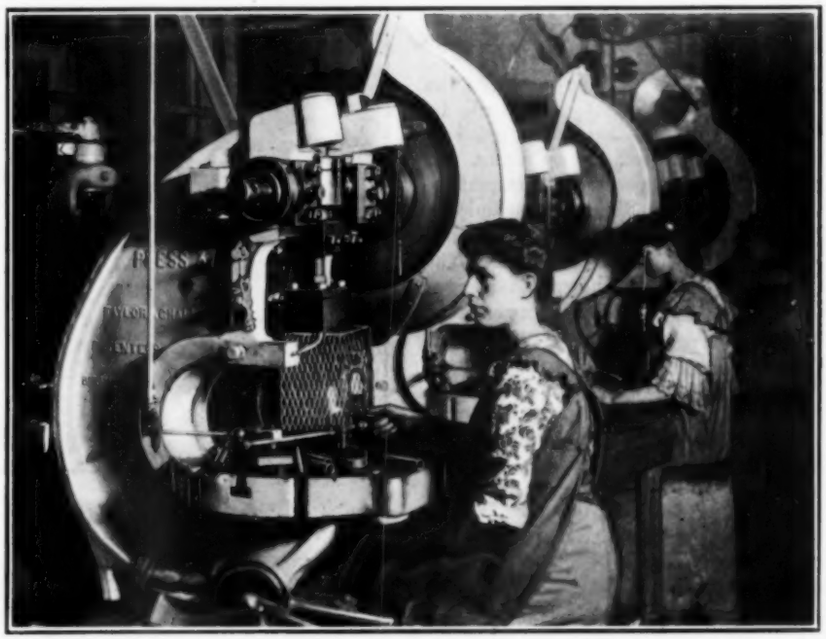


FIG. 4. PRESSES WITH PUNCHES AND PULLEYS GUARDED

riveted joint is used with a steel plate, with the valve placed opposite, for balance. A compressed-air plant is used for pumping up the tires, the ordinary pressure being 100 pounds. In this department, as most others, the aim is to keep everything together.

Each range of polishing lathes or other machine is placed over a trench. Each pair of trenches is cleaned by a fan which delivers into a central duct, which is again cleared by a 7 foot 6 inch Sutcliffe fan into the tower. Tilghman's sand-blast system is used for polishing and cleaning

FIG. 5. WHERE BICYCLE FRAMES ARE MADE UP BY HUNDREDS

Spokes for the wheels are gaged and cut to length by a circular cutter and then have the thread rolled on them by means of a top and bottom die, the threads being cut on an angle, and the top die moving while the bottom die is stationary. In this method, fairly well known of course, the metal is increased in diameter so that the bottom of the thread is almost equal to the diameter of the wire, and a 16-gage wire carries a 15-gage thread. Each pair of dies will thus screw some 125,000 spokes at the rate of 13,000 a day.

Protecting the Operators

In an older part of the works is the power-press department, operated by women. Every tool here is guarded in order fully to protect the operators, and also to meet the government inspectors' requirements. Several types are employed for this purpose, a wire guard, for instance, being illustrated in Fig. 4. The pulley guards are also shown in this view. The ordinary operations here include the production of seat pillars entirely from tube, cold. The tubes are bent in another shop, the method being to load with resin, bend under the press and melt out.

The tool-making department forms part of the power-press shop. It is fully equipped with the newest precision tools. Cincinnati grinders and full universal millers are among the latest additions to the shop, which employs 33 men on tool production alone.

From the iron-polishing shop, with the usual emery-wheel and similar equipment, the dust is extracted by a special system.

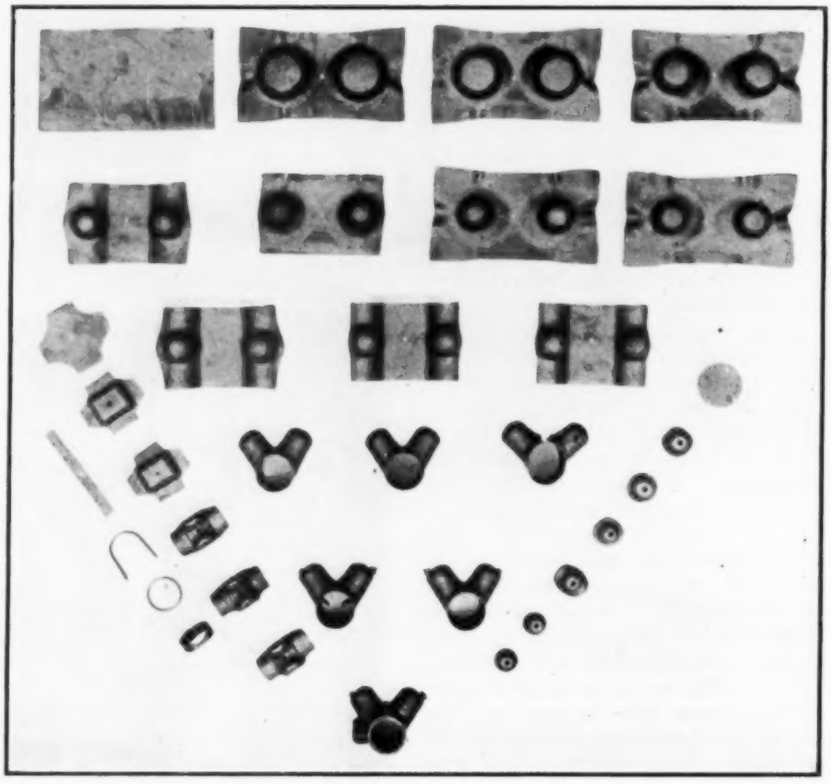


FIG. 6. DIFFERENT STAGES OF DRAWING UP A BOTTOM BRACKET

purposes, a 35-horse-power motor driving the compressor. In the laboratory all metals, rubber, etc., are tested physically and chemically and, where necessary, by micro-photograph.

Making Frames in Quantity

On the other side of the road is the original Coventry factory. This is devoted almost entirely to the preparation of tubes for building up frames, etc. An operation which immediately strikes the eye is the removal of superfluous metal from a brazed joint on a fork blade. This is not done by grinding. The article is clamped on the machine table and the excess is milled off, this being found the quicker method. High-speed steel is used so as to withstand the brazing mixture. Orders for the cycle tubing used here run to more than half a million feet, and the material is taken in on runways and distributed in the same way.

In the construction of the frame, and in fact in all parts, the design aims at stiffness, with large surfaces for brazing when necessary. Fig. 6 shows, with some omissions, the press process. The crank-axle bracket shell is formed, as shown at the top, thickening bushes, illustrated at the side, being placed one at each end of the bracket to provide the material needed for tapping for the ball cups. Between the two shell lugs, a saddle piece is held by a wire, while the chain stay thimbles are shown on the right of the illustration. The frame-making throughout is worked on jigs and to templets, the jobs being examined between processes. All stays have solid ends, not material overlapped, and solid jaws are provided in the forks. The frame complete weighs less than 5 pounds.

Screws are avoided as far as possible, parts being pegged in instead. The reason is that a screw thread when cut off flush leaves a very thin thread or shaving of material which is very liable to be polished out in subsequent operations.

The enameling ovens are heated by water under pressure, and form the largest installation of the kind in the British cycle trade.

The temperature for baking the frames is about 340 degrees Fahrenheit. The frames are gaged, and set, if necessary, in the appparatus shown in Fig. 7. These tools, like many others in the works, were made by the firm itself. The frames are tried twice, once in the bright and once in the black, and the care here exercised has done much toward the success of the interchangeable system on which the works are run.

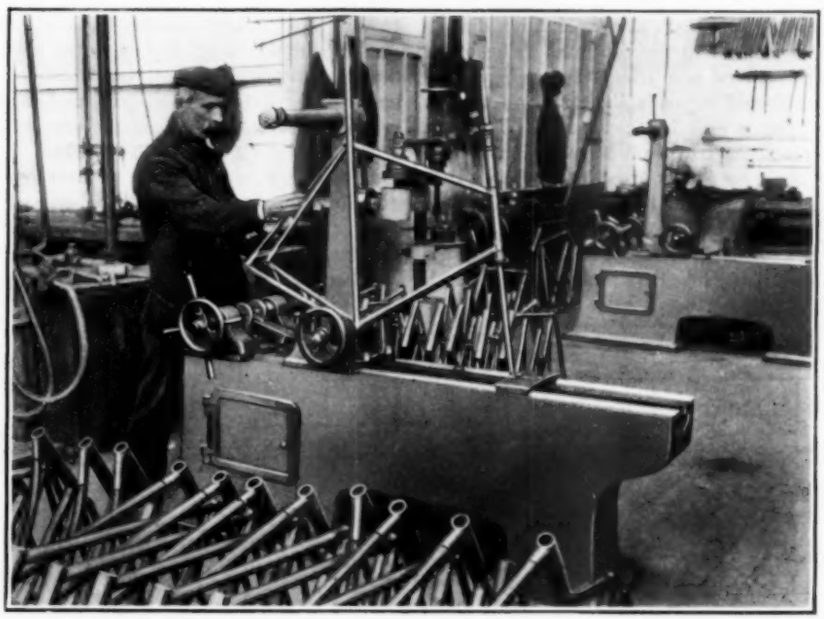


FIG. 7. TESTING ALINEMENT OF FRAMES

Quality and Tests of India Rubber

By A. N. Hammond

I have rather a severe criticism to make on the article on testing rubber at page 463.

The best known test of anything is a practical one, in the place it is to be used and then noting its behavior.

A vulcanization test is of no practical use unless the article is to be used where it will be subjected to a vulcanization test, such as steam packings, etc. A very little experience will enable one to tell if rubber is properly vulcanized. Properly vulcanized rubber has no stickiness when two surfaces are brought together. If dented with a drill point (a lead pencil, for instance) the hole will close up; if a strip is stretched almost to the breaking point it should almost instantly return to its original shape.

Grades of Rubber

The article states that the only Caoutchouc is the Para—of which he leaves three grades unmentioned. Although the fine Para is second to none its range of usefulness is somewhat limited. It is useless for friction purposes when used alone. Pinky Madagascar is preferable for some other purposes, such as hard rubber combs, etc., being more elastic than the Para variety. South America and Central America furnish tons of rubber, some of which are equal to the finest Para. Manaos grades are also in many instances its equal.

Rubber in various forms, coming from many different varieties of vegetable life, is collected almost throughout the entire torrid zone of the world. Taking the lowest grade, the Pontianak from Borneo, next the soft flakes from Africa—then probably the Borneo proper (the first named being a bastard gum), Cameroons, Sierra Leone, Congo Ball, Black Madagascar, Coarse Para (both islands and up river), Caucho, Bolivian, Centrals, Medium Para, Pinky Madagascar and Fine Para. I have enumerated a few of the varieties, the prices of which one will find quoted in any of the rubber trade journals.

Rubber has also been extracted from the milkweed, but this has not been done profitably as yet.

About Adulteration

No doubt rubber has been very badly adulterated in the past, and will continue to be to the end. Still one must bear in mind that all ingredients added are not of necessity adulterants. Even if sulphur is the only known vulcanizing agent, it is by long odds not the only good compound. Practically it is useless as an adulterant, too much will ruin the finest Para and therefore it is valueless for reducing the cost of the compound. To use a world known argument, linseed oil is probably the life of any paint, still no one uses linseed oil of itself.

The various mineral oxides, carbonates, hydrates and sulphates, used as compounds, are used to arrive at some definite result. The first idea certainly of any rubber-works chemist is to produce a compound that will do the work required, the second thought is to make it a commercial success.

Pure gum is rarely used, excepting possibly for rubber bands, gloves and some druggists' sundries. In what is called pure gum in packings, etc., the term pure is only used to distinguish between them and the cloth insertion variety.

Other Tests

Another test for the quality is destructive distillation. This is based on the fact that rubber will burn, having scarcely any perceptible ash, and that the compounds will be left as a residue. For marine valves, etc., where the principal deleterious compound in which they come in contact with is oils. Cut a sample valve into small pieces and cover with benzine and note the action. If properly vulcanized, the benzine should have no effect for a short length of time, say 24 hours; if under vulcanized the pieces will swell. This, of course, only shows "undercuring," as it is called in the trade.

Overcuring will show by the outer surface being harder than the inside, and showing cracks when bent. Also in the smell as the rubber smells burnt. One other test is to try the specific gravity which = .945 to .955. This is based on the fact that rubber is lighter than water, and that the majority of the compounds are heavier than water. For one who has never tried to test the specific gravity I would advise them to read the article in the "Encyclopedia Britannica," as it is very good.

The Test That Counts

In conclusion I might state that no single test excepting the first-mentioned (actual usage) is conclusive. One safeguard certainly is to buy none other than guaranteed articles from any of the responsible manufacturers (whose names are legion) and also be sure to state the exact conditions under which the article is to be used, and I think that the failure, if any, will be found to be as much the fault of the purchaser as the manufacturer.

One of the causes of a serious loss in the transmission of compressed air is pumping the air of the engine room rather than air drawn from a cooler place. This loss amounts to from 2 to 10 per cent.

Forging Press Dies for Making Hammers

By Pressman

The advantage of forging hammers and similar tools so as to preserve uniform shapes and density of metal was recognized before the advent of the forging press, but this has helped matters very much and its good points have been utilized by many firms. It is rapid and can handle a large variety of work, the cost of the work depending largely on the dies used, as they directly affect the time taken for a man to handle the different pieces.

I will endeavor to show their proper construction in as simple a way as possible, and begin on the simpler forms first.

Save Unnecessary Movements

The main object in the dies should be to do as much as possible and concentrate them in rotation, so that each operation will follow the other without the workman having to lose time by doing unnecessary traveling from one end of the press to the other. This takes time and the steel gets cold, making it harder on the dies and press and very often, hard on a man's patience.

First comes the shear blades which are of peculiar shape, as they are designed for nothing but hot shearing, and must cut the bar as square as possible, otherwise the steel buckles in squaring the face of the hammer, and requires extra work.

In Fig. 1, *B* shows the bottom blade with the guide to keep the top blade from overlapping, but still giving a tight contact for good work. *A* shows the top blade and on its sharpness and proper "set" depends the squareness of the cut and length of the piece, for when dull it "slides" the piece in shearing and causes variations in weight, and as every piece should be of the same size, an extra ⅛ inch will count up to quite a large amount in a day's run. The punch, punch block and stripper come next, and the adjustable gages on the punch block for locating the eye of different size hammers. *C* shows the gages attached to block. The front and back is practically the same. The stripper is shown over it, and the punch-holder with punch used. Where more than one press is in the shop the punch-holders should all be made the same, so both punches and holders are interchangeable for any machine.

Making a Double-faced Hammer

Suppose we want to make a double-faced hammer, like *N*. This requires top and bottom drift dies *E* and *F*, smoothing dies *G* and *H*, both top and bottom being the same in this case, and be sure that the working surfaces be rounded nicely to avoid cutting the hot steel.

The breaking dies *I* and *J* are the same as dies *G* and *H*, except having ¼ inch more space between them for the edges of the hammer. The surfacing die is merely a broad flat top used to keep the hammers of one length before punching and should be made short enough to take in the largest hammer made. The difference in size and length of hammers is made up by different thickness of iron plates laid on the bottom die table.

These dies will make from six to ten sizes of hammers, by making them for the largest size first and putting ⅛-inch liners under the dies for each smaller size hammer made. All dies are shown in place on the press for each operation in Fig. 1.

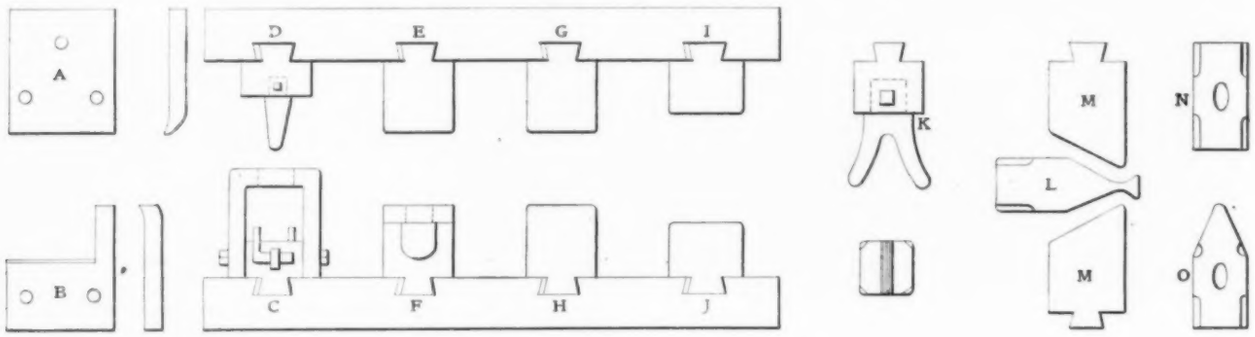


FIG. 1. DIES FOR FORGING HEAVY HAMMERS

The Finish of the Dies

Great care is required that the dies should be finished as smooth and true as possible, as any tool marks will work into the hot steel, and if not true they not only leave high and low places on the work, but get the tool out of square. These marks sometimes cause hammers to crack in hardening. All working faces of dies should be hardened.

In making a cross or straight peen hammer the dies *M M* leave the peen in the shape at *L*, the surplus is snipped off by the hot shears first shown.

For economy and saving of machine work, a great many of these dies can be made with a cast-iron base saving two-thirds the cost of die in both steel and machinists' work, after the first set is made. But great care must be taken to have the casting of the toughest possible mixture, otherwise it is liable to crush and get out of true. The sides are also liable to fracture where the gib of the steel face is keyed on. I think on the whole it is better to make these foundation blocks of low-grade steel. They should be put together with keys and dovetails, using large fillets to strengthen the sides. The steel faces should be at least one-third the hight of finished die. When made too thin, they soon get soft, wear out of shape, and buckle, for they are constantly subjected to great heat and strains while in use.

Few Dies Needed

It would seem at first glance that the variety of work on a forging press would require a very large number of dies, but such is not the case. For with the addition of sub-blocks a great many dies can be used for different purposes, and even without them it must be remembered that a latitude of 1½ inches is possible. In tool work we seldom forge a piece over 3 inches square, and one set of dies will answer for from 10 to 15 different size articles, as 1/16 inch taken off or put on the hammer makes quite a difference in the weight, and often the only variation will be in the length, which makes several pounds difference in weight.

We will take for example the single and double-faced spalling hammers shown in *A* and *B* by Fig. 2 and the stone sledge *C*. One set of dies will make all of these tools, the only difference being in the bevels and the "pinching" dies for the cutting ends. The straight sides are all the same, for no upsetting dies are used on these hammers, as the beveling dies to break down the edges on the stone sledges take their place. A certain amount of stock must be added to both *A* and *B*, as they "kick back" unless pinched down as in *D* so as to leave about ¾ inch to be sheared off. The shear blades should be sharp for this, as when they are dull they drag and this fin must be ground off. Most of the dies for this are similar to those in Fig. 1.

Sub-blocks should be used for dies that come into almost constant use in "pinching" down the tops of *A* and *C*. It must

not be thought that the press will pinch it all down at one stroke, for it will not; a little is taken at a time, until the operator is sure the press will not "stick," then it is extended over the die and pinched down as at *D*. The pinching dies are *E* and *F*, with side views at *G* and *H*.

Making a Miner's Maul

A coal-miner's maul is shown at *I*, Fig. 2. The dies are largely the same as for the other hammers, except for the beveling dies *J* and *K*, shown in side view at *L* and *M*. These are for the short end or head, and similar dies are needed for the longer bevel of the other end. These are the only separate dies needed.

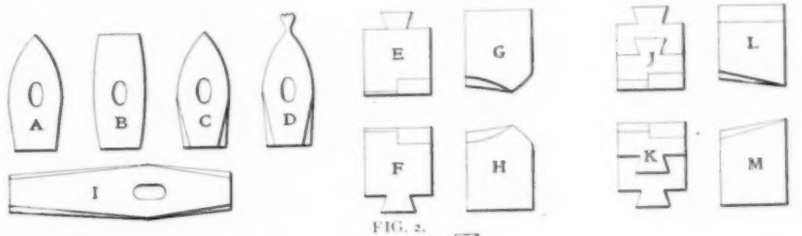


FIG. 2.

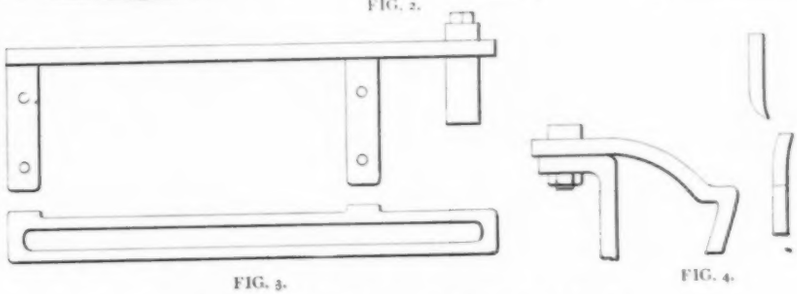


FIG. 3. FIG. 4.

DIES AND GAGE BLOCK FOR FORGING HAMMERS

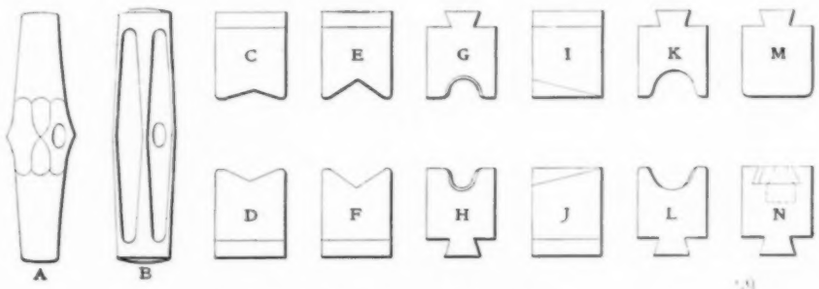


FIG. 5. DIES FOR FORGING SPIKE MAULS

While on this subject it would be well to show the arrangement of the gages and gage bar, Fig. 3. This extends entirely across the back of the machine and should be slotted so the gages can be moved to any desired position.

Fig. 4 shows an end view of the gage and also gives an idea of the relation to the shear blades shown at the right. This gage should be stiff and rigid, as it has to stand some hard knocks.

In making the spike mauls shown in Fig. 5 at *A* and *B*, the forging press shows some of its best work, as they come out of the dies with a polish that could not be outdone in a lathe. Of course the dies have to be very smooth to do so neat a job, but they naturally get slick after they work awhile. The swaging dies *G* and *H* should have lots of clearance, else they leave bad marks or pinches on the maul.

One setting of dies will make both patterns of these mauls, but the reducing dies *C*, *D*, *E* and *F* are not used on maul *B*. The combination dies *I* and *J* and a much larger swage *K* and *L* are used instead.

Details of the Eye Punch

I wish to go into some details regarding the eye-pin die *N*, as the plate *a* is generally fastened to the block with half-inch cap screws and the hole made large enough to take the largest pin used. It is a much better plan to sink the plate in the block and fasten with a key, as shown at *N*. By this plan three plates can be used for different size pins, and it takes but a moment to change them. If one plate is used with a large hole and small die, the pressure of driving the pin through the eye causes bad looking marks around the eye which cannot be worked out, and I have seen a great deal of good work spoiled from this cause.

Three plates with oval holes, say ¾x1 inch, 1x1¼ inches, 1¼x1¾ inches, would cover the requirements, and it is a small matter to drive the key out, change to the plate best adapted to the size of the hole and do a neat job. The hole in the plate should be ⅛ inch larger than the eye in the tool, and if this rule is followed a neat job is assured and no scrap made.

Horse Power vs. Mare Power

Any of the numerous engineering textbooks gives us the definition of horsepower, but they are all silent on the question of mare power, and hereby hangs a tale.

He was only a youngster, but he filled (pardon me, he sat in) the manager's chair of an engineering works.

Displayed upon the wall in conspicuous positions were the diplomas from the engineering colleges from which he had graduated, and as he sat at his roll-top desk and stroked his budding mustache, a visitor was announced.

"Hello, Mr. Brick, come in! What can I do for you?"

"I am looking for information," said Mr. Brick, "and I suppose you are the man to give it to me. I have some clay to move in my yard from a certain point to another point, and I want to know what horse-power will be required to do the work?"

The manager reached for a pad with one hand and a pencil with the other, and started to work.

"Oh, yes; so many tons, so many feet in so many hours." He figures away, and finally gets as the result 45 horse-power.

"That kills the proposition," said Mr. Brick. "I have not that much power to spare. But before retiring I should like to ask you a question: What is the difference between a horse-power and a mare power? One old broken-winded mare is doing the work now, and if it is going to require 45 horse-power to do this same work with a belt conveyer, I think it will pay me to stick to the old mare."

Exit Mr. Brick.

Increase in Rail Failures

There is an almost unprecedented epidemic of broken rails that is keeping both the maintenance of way and the motive power departments of the large railways in anything but an easy and comfortable state of mind. And the breaks do not always happen on curves either or with electric trains.

When we learn that one division of a certain road reports 600 broken rails in the last six months, a hundred a month, where a few years ago they were practically unknown, we can readily understand the anxiety of the officials in charge.

The only explanation that the railway men have to offer is the character of the steel being used in the rails of the present day and intimate that, while the tensile strength may be as high as ever, the many breaks indicate an inability to resist the shock of trains in an unmistakable manner.

The Central South African railway administration proposes to set up machinery for the extraction of oil from the local castor-oil plant.

Machines and Measuring Instruments for the Brinell Hardness Test

Since this method of testing the hardness of metals has come into general practical use, a large number of special machines have been designed for the purpose; it would, however, lead us too far to describe all the different designs, and the authors have therefore limited themselves to describing a few of them in some detail.

Prof. A. Martens has designed a machine, Fig. 1, for this purpose for the Royal Testing Station, Gross-Lichterfelde

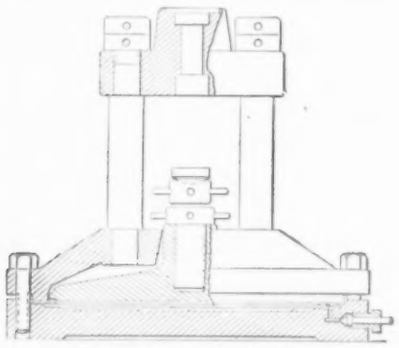


FIG. 1. HARDNESS TESTING MACHINE OF PROF. A. MARTENS

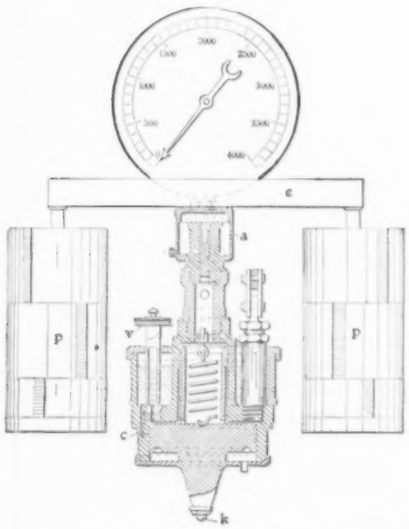


FIG. 2. HYDRAULIC BALL-TESTING MACHINE

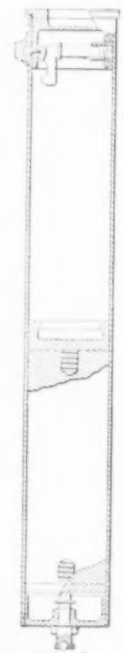


FIG. 3 Portable Impact Ball-Testing Machine

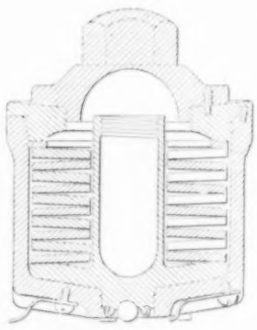


FIG. 4 Another Impact Ball-Testing Machine

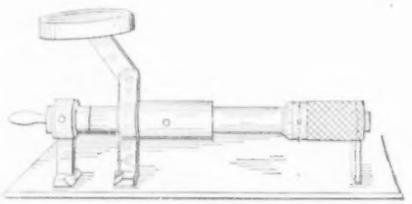


FIG. 5. INSTRUMENT FOR MEASURING LARGE BALL IMPRESSIONS

commencement of the test. The pressure which is applied is measured by a pressure gage connected with the diaghragm-box. A hollow space is left in the uppermost part of the machine for inserting an apparatus by which the depth of the impression made by the ball can be measured.

The Alpha Company, of Stockholm, has designed a good ball-testing machine, which is easy to manipulate. It is a hydraulic press, the steel ball being fixed on the piston. The test piece is placed on an adjustable table provided with ball bearings. The piston fits into the cylinder without packing. The pressure in the hydraulic cylinder is produced by a small hand pump, and is measured by a pressure gage. The machine is also provided with an apparatus for controlling the pressure, so that the desired pressure cannot be exceeded. This latter apparatus is directly connected to the pressure cylinder and consists of a smaller cylinder inside which a piston moves frictionless. This smaller piston is loaded with dead weights corresponding to the desired pressure, and when the latter is reached, the piston, together with the weights, will be lifted and will remain floating. Fig. 2 shows the plunger pump, weights and dial.

Brinell has also designed a portable apparatus for impact ball tests, Fig. 3. The apparatus consists of a steel tube in which a weight of 5 kilograms can move. The weight is held in position at the topmost part of the tube by a hook fixed to a small transversal spindle, which ends in a button outside the tube. The apparatus is accurately placed in a vertical position. By pressing the button the weight will be released, and will fall, without friction, direct upon a piston placed at the bottom of the tube; a small steel ball is fixed on the end of the piston rod. The hight of the fall and the size of the weight are so adjusted that the impression made by the ball in a specimen of iron, containing 0.1 per cent. of carbon, is equal to the impression which would be caused by a static load of 3000 kilograms.

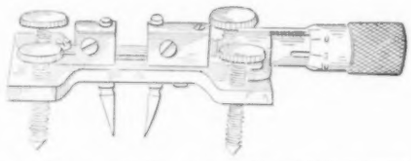


FIG. 6. ANOTHER MEASURING INSTRUMENT FOR LARGE BALL IMPRESSIONS

Another apparatus for impact ball testing has been designed by Guillery, Fig. 4. It consists of a hollow piston, which can move inside a cylinder. T
closed at the top, and the co
head, which receives the shock of th
pact. The steel ball is fixed i
manner to the bottom of the p
side the cylinder and surrou
greater part of the piston are placed a number of Belleville springs, one above the other, filling up the entire space. By applying a sufficiently strong force of impact the springs will be so much compressed that the bottom part of the cylinder will come to rest on the test piece,

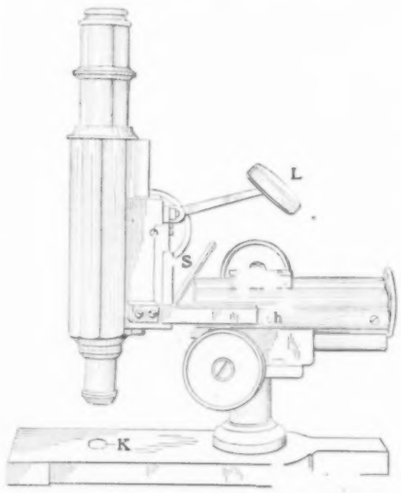


FIG. 7. MICROSCOPE FOR MEASURING SMALL BALL IMPRESSION

*Abstract of report presented to the International Association for Testing Materials, Brussels Congress, 1906.

while at the same time the steel ball will be pressed into the test piece. It is evident that by a proper adjustment of the springs, it is also possible with this apparatus to obtain ball impressions which are equal to those produced by a static load of 3000 kilograms.

Attention must be called to the importance of placing the test piece on an inelastic foundation when submitting it to impact ball tests.

The firm of Huber & Wagner, St. Ludwig, in Alsace, have designed some instruments, Figs. 5 and 6, for measuring the large impressions made by a 19-millimeter ball, which is used in Germany for testing the hardness of rails. This kind of apparatus does not, however, suffice for measuring smaller impressions; in the latter case different kinds of microscopes are used. Brinell has designed a microscope for this purpose which has been largely used, and which is sold by the firm of C. Reichert, of Vienna. As will be seen, Fig. 7, the microscope is provided with a vernier, and is adjustable in two directions. The Alpha Company, of Stockholm, has also placed a microscope on the market, which is provided with an eye-piece micrometer. The accurate position of the instrument relative to the ball-impression is adjusted by simply moving the microscope by hand, without the application of screws and the like.

Amos' Observations on April First

About 5 o'clock in the afternoon of April 1 Amos Matson walked into the engine room to have a chat with his friend the engineer, George Campbell, by name.

Amos was office janitor in a large machine shop, and was also a generally handy personage for the superintendent. He had been a boy playmate of the super's and thus was a little privileged.

"Wal, George," said Amos, after seating himself on top of a screw jack kept to pry the engine off dead center, "how many times have the youngsters fooled you today?" "Not a once," replied George, "although some idiot did try to mix water with some of my engine ile."

"Haven't heard tell of the doings in the shop, have you?" continued Amos, and without waiting for a reply he told of the jokes.

"The green errand boys caught it for fair. There's a difference between running errands and being run on errands, and to-day it was mostwise being run on errands. All of the kids were in the class of 'there also ran.'

"One youngster hunted high and low for the proverbial left-handed C clamp. Another tried to find a tailless lathe dog. He must have thought it was a mongrel pup from the jollies he got. Another asked for a half pound of sweat to sweat in a bushing, and was advised to hustle around and make it.

"Bill Tower's Bob hunted the planer job over for some taper parallels, and thus the boys were kept going. But you should have seen Bill himself at noon when he stuck his foot on a lively bull-head in one of his street shoes. Wal, now, the air sure resembled earthquake conditions for a spell.

"But the best joke of all was played by the old man himself." "What was it?" asked George, with interest.

"Wal, you know the old locomotive at the end of the yard used sometimes for switching?" "Aye," assented George. "Wal, some of the yard boys have been crawling into her firebox lately in working hours to play cards by the light of a petticoat lamp. The old man was on. They were in there this afternoon, and he knew it. He sent for me, and told me to get an armful of oil-soaked waste, put it in her smoke box, set fire to it, and then throw a gunny-sack over the top of the smoke-stack.

"So I went down to the screw-machine job, and got a lot of waste soaked full of some of that last degenerate hog grease that the boys are kicking about.

"When I got out to the engine the old man and the yard boss were in the cab. I noticed that the fire door was open just a little, but the boys inside were on and mum was the word. I put in the waste, gave it the match and how it did smoke! My jumper smells of it now.

"Pretty soon a little noise came from the fire box, then a stifled cough, and then the door swung back and a grimy man's hand holding a dirty card hand, came out through the door, followed by the rest of a man.

"Then one after another the bunch crawled out, a dirty, smoky, shame-faced lot. The last fellow was nearly all in.

"How the old man chuckled at his joke, a constructive joke, he called it. I laughed myself sore to see those fellows smoked out like rats and slink away." "They will not get into that box again," remarked George. "Right you are," said Amos, "there are better ways of keeping discipline than by throwing things around the shop and shooting everyone full of cuss words."

An Adjustable Guard for Emery Wheels

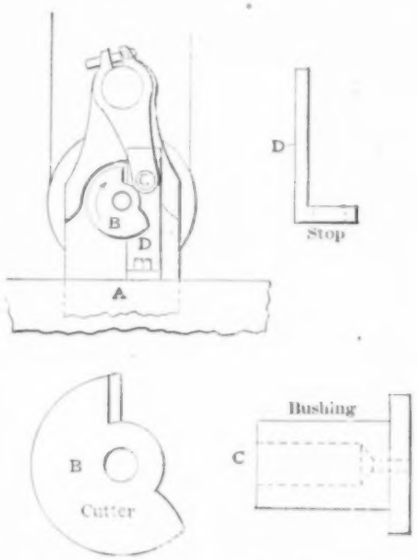
By Robert Grimshaw

Legislation is being passed in some sections for the protection of workmen from the bursting of rapidly revolving wheels, and many devices for this purpose are being offered. Some of these are in the line of increasing the tensile strength of the wheel itself; while others are merely guards. As it would be very inconvenient to have a protective guard much larger than the wheel, and as different sizes of wheels are often employed on the same machine, it is desirable, in order to avoid having a great number of such guards, to have them adjustable. A device for this purpose is shown in the accompanying illustration. It is composed of a number of caps of U section, overlapping each other and pivoted together in such a way that they may be curved around wheels of different diameters, surrounding all the circumference, except the part necessary for the introduction of the tool to be sharpened or the piece to be ground. The caps which form an inclosing chain, are held to the proper circle by adjustable bolted straps.

Shearing Off Dowel Pins in the Milling Machine

By Geo. E. Salomon

As I have to make about 200,000 dowel and hinge pins each month, I rigged up a device on a hand milling machine to chop them off from a coil of wire. This fixture I found to be much more rapid in its action than the automatic machine I had been using.



SHEARING DOWEL PINS IN THE MILLING MACHINE

At *A* is shown the device attached to the milling machine, *B* the shearing blade is on the machine arbor, *D* the stop is fastened to the table and *C* a special bushing takes the place of the center in the overhanging arm.

The flange of the bushing is set close to the cutter and the edge of the hole is kept square to give a good shear.

The spindle is speeded to 200 revolutions per minute and a boy pushes the wire through the bushing and against the stop. A pin is sheared at every revolution.

Rigging up to Turn and Re-fit Large Pistons—A Crank-pin Turning Rig—etc.

By Dixie

A number of articles have appeared in the American Machinist from time to time, on doing large jobs on small machines, but I have yet to come across one in the same class with that which I here describe. This not only is a large job done in a satisfactory manner in a shop having small tools only, but also it shows how an efficient special machine was built from material rescued from my old friend and standby, the scrap heap.

The plant where the work was done is a large power station with eight compound engines having cylinders 42 and 86 inches by 60 inches stroke; steam pressure, 180 pounds; revolutions per minute, 75.

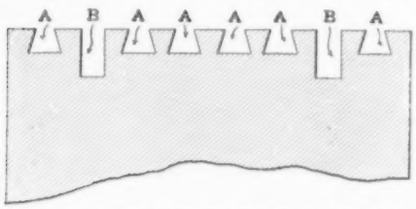


FIG. 2. SECTION OF PERIPHERY OF PISTON

These engines were built to develop 4500 horse-power, but are run anywhere up to 6000 horse-power. Seven engines are in commission at a time while the stand-by engine is kept just turning over so that at a moment's notice in case of accident it can be started at full speed.

During eight hours of the day the entire eight engines are running.

This job has in the past been a man killer as far as chief engineers are concerned, but the present incumbent, A. W. Jurisch, seems to be pretty far ahead of the game at present and likely to remain so.

The pistons of the low-pressure cylinders are 86 inches diameter by 15 inches deep. Two inches from each face there is a packing-ring groove *B*, Fig. 2, 1¼ inches wide. The pistons cost when new, $664, and when put in are about 0.032 smaller in diameter than the cylinders. After a year and a half they are found to have worn approximately ⅜ inch, and if they could not be repaired would be a total loss.

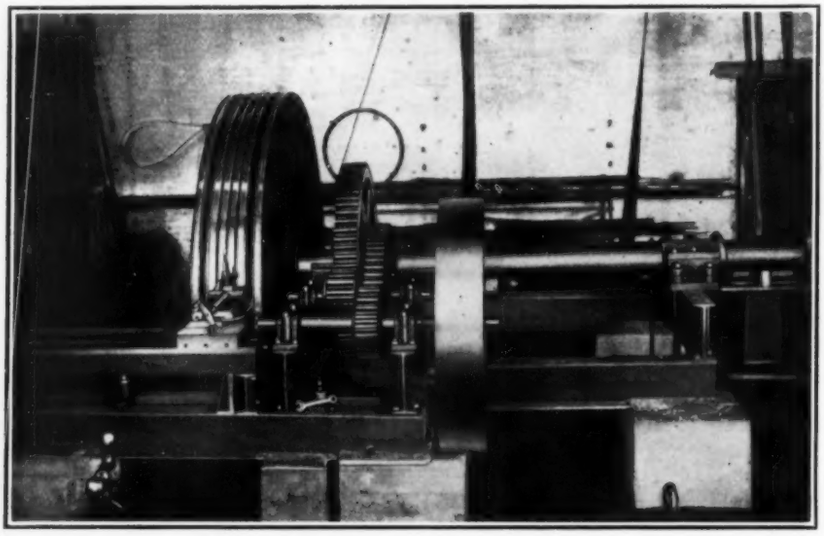


FIG. 1. A LATHE BUILT FROM SCRAP

Mr. Jurisch decided to try cutting grooves in one of the pistons and lining it with babbitt. This was done and gave such highly satisfactory results that as they become worn and can be spared the other pistons receive the same treatment.

The largest lathe in the repair shop is a 24-inch Putnam with a bed about 10 feet long. It was, of course, out of the question to turn up the 86-inch pistons on this lathe, but it came in for the work on the piston rods later on. Out in the scrap heap was a bent piston rod—not very much bent, but just enough to put it out of business for the work for which it was intended.

This was brought in and a couple of journals turned on it about six feet apart and true with the taper seat for the piston. Two bearings were fitted to these journals. Masonry piers were built 18x24 inches and high enough to suit the job. To these 10x5-inch I-beams were secured by bolts built into the masonry. On top of the 10x5-inch I-beams, 12x5-inch I-beams were bolted, and to these the two bearings were secured, all of which is shown in the half-tone, Fig. 1. The slide at the left, upon which the tool slide is mounted, is equipped with a carriage having screw feed, which serves for longitudinal feed for the tool. The tool slide is taken from the 24-inch lathe previously referred to. The pistons are mounted on the end of the piston rod which forms the spindle of the machine, and six dovetailed grooves 1¼ inches wide by ½ inch deep are turned in them as shown at *A*, Fig. 2. This job took eight hours which is pretty quick time. After grooving, a wooden form lined with asbestos board and taking in about 1/6 of the circumference, is clamped to the piston and the grooves are poured with babbitt. The six segments of babbitt are not allowed to abut, there being a space of about ½ to ¾ inch between their ends. After all the segments are filled with babbitt, the babbitt is pened into the groove; the pening, at the same time that it compresses the metal, spreads it so that the segments creep toward each other and makes a perfectly tight joint at their ends. After the segments are all pened solid they are turned to size, the whole job taking but three days.

The first cylinder fitted with one of these doctored pistons has now a fine glazed surface on it and is the only one that has.

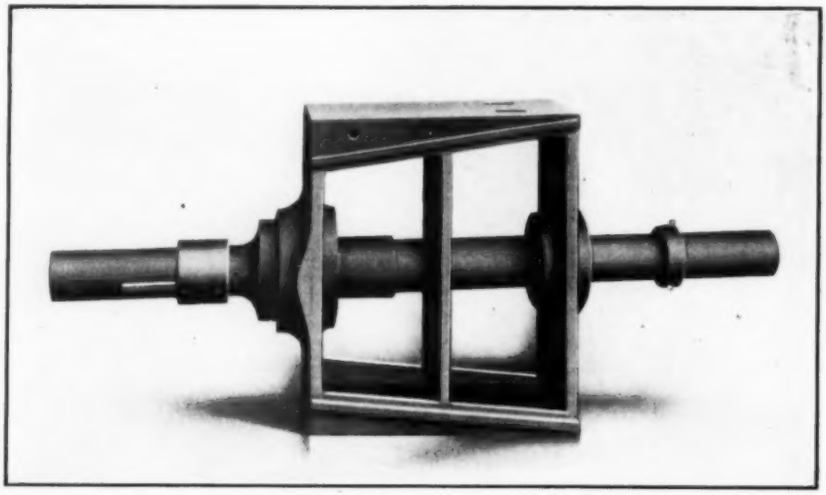


FIG. 3. RIG FOR TURNING CROSSHEAD SHOES

The crosshead shoes of these engines are also babbitt lined and are turned to size in the same fixture, but between the

bearings. The rig shown in Fig. 3 shows a spare crosshead secured to a shaft with journals on it which fit the bearings on the turning rig. The large gear on the spindle of the turning rig is split so that it can be easily shifted from the one job to the other. The tool slide is also portable, of course.

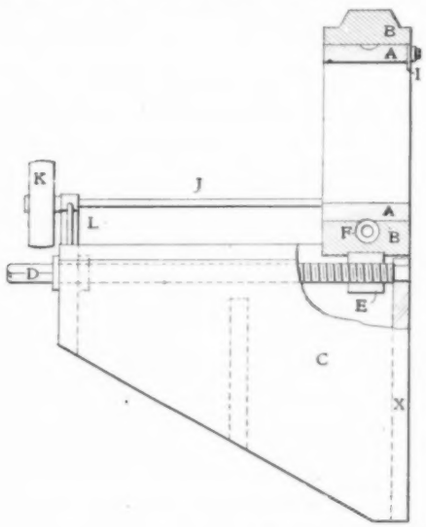
A Crank-pin Turning Rig

Fig. 4 shows a crank-pin turning device devised by Mr. Jurisch. In this rig *A* is a rotating sleeve journaled in the casting *B*, which slides on the angle casting *C*, being actuated by the screw *D*, working in the nut *E*. A worm *F* meshes with worm teeth cut in the center of the periphery of *A*. The worm *F* is driven through the worm gear *G*, the worm *H*, and the shaft *J* by the pulley *K*. The sleeve *A* carries the turning tool *I*. The sleeve *A* is not shown in halves in the illustration, but can be so made. It is of course understood that no attempt has been made to make the drawing to scale.

The face *X* of the angle casting *C* is set true with the crank web, and the sleeve *A* concentric with the crank pin. The tool *I* is set to depth of cut and the machine is started. The feed is by means of a star wheel on the end of the screw *D*.

Turning Long Piston Rods on a Short Lathe

The spare piston rods for these engines are about two feet longer than the longest lathe in the shop. The threads on either end for the nuts and the taper for the pistons have been left a "little full." When it came to fitting a new rod, these oversizes were noticed, and it was up to Mr. Jurisch to devise some means for doing the job of turning them to size.



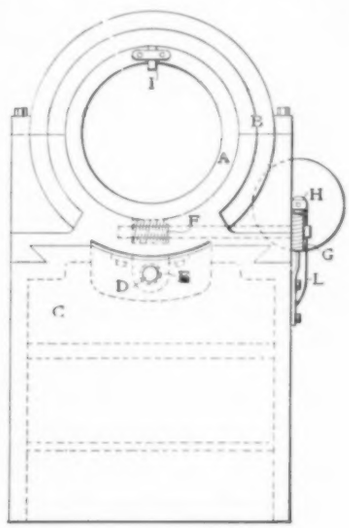


FIG. 4. CRANK-PIN TURNING RIG

This is shown at Fig. 5. *A* is the piston rod, *B* is a small cast-iron piece drilled for three cap screws. The ends of the rods are drilled and tapped so that the piece *B* can be secured to it. The piece *B* is caught in the chuck and the rod is supported in a steady rest having wooden jaws. Even if the piece *B* is not central with the rod, the chuck jaws can be easily set so that the rod runs true. This made it possible to reduce the threads and the tapers, instead of re-threading the nuts, which would of course prevent their being interchangeable, as the threaded portions on the spare rods were not all exactly alike.

A Piston-nut Wrench

Another useful tool is shown at Fig. 6. It is used for tightening the piston nuts

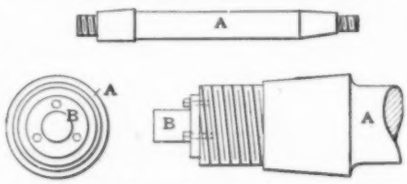


FIG. 5. RIG FOR TURNING LONG RODS

when in place in the engine. The flange *A* fits, with a little play, the man-hole in the cylinder cover. The piston is brought to top center, the wrench is put in place, and the flange *A* steadies it so that there is no danger of its being displaced while the wrench bar is turning it.

Journal Bearings and Piston-ring Fits

By Walter de Sanno

I have been reading the articles on the draw-filing of journals to make them run cool.

When I went to the Meadville shops of the old Atlantic & Great Western R. R., I found that it was their practice on new wheels for tenders or cars to draw-file the journals with a bastard file. The bearing surfaces of the corresponding brasses were machined by a spiral-toothed milling cutter of a larger diameter than the journal, and running on the lathe centers. The brass was laid on the end of a plank. The plank rested on the lathe carriage, the tool post having been removed. A man's weight on the end of the plank forced the brass upward and against the cutter. The method was crude but quick, and did a good job. The brasses had no lining metal.

These bearings ran cool, although they seemed to contradict the ideas of well-bred practice and upset some of our fine-haired theories that a job must be just so or it would not work.

It was my practice for a long time to scrape and fit a brass down to a perfect bearing, to have it run cool; and even then, as a way-engineer friend of mine used to say, "They would get hot before they left the round house."

Close, exact work is all right when we want exact results, but too close work in a great many lines does not give good results.

I once saw a foreman in a Government shop use an oil stone and micrometer in sizing a square-nosed tool for cutting the grooves for snap rings in a piston head. The rings were turned, cut off and scraped down on a surface plate until they would slip into the grooves. I have had occasion to overhaul engines having pistons made with such fits. The only way in which the rings could be removed was by driving a narrow chisel under them and breaking them out. In effect the piston heads were solid, the rings being stuck fast in the grooves.

I once had a pair of snap rings to fit for a 15x22 locomotive cylinder. We had no castings except some that were ⅝ inch smaller in the rough than the cylinder. We trued up the castings, cut off the rings and sawed them. I then took a cast-iron plate, struck a 15-inch circle and peened the rings to the circle. They were then sprung into the grooves to break joints and the engine was sent out on a passenger run. In fact the engine ran afterward with those rings and there was no trouble from steam blowing by the piston. Sometimes we "strain at a gnat and swallow a camel."

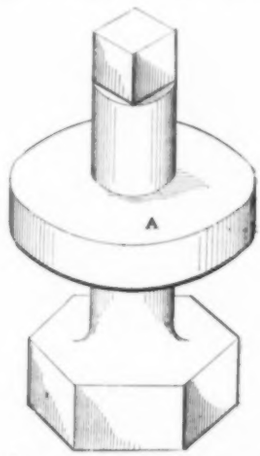


FIG. 6. WRENCH WITH STEADY FOR PISTON NUTS

Some Properties of Vanadium Steel

How Small Quantities of Vanadium Affect Different Mixtures of Iron and Steel and Where It Is Most Useful

BY E. F. LAKE

Vanadium steel is the latest product of alloyed steels that has been brought out by the steel makers in the past few years, and while there are many things to be decided, by practical tests, as to its good or bad qualities, enough is known to warrant its being placed among the high grades of steel.

Like many of the materials used to alloy steel to raise its tensile strength, elastic limit, elongation and resistance to shock stresses, vanadium was discovered by the chemists about one hundred years ago, and was christened Erythonium, this being confused with the better known element chromium. About thirty years afterward it was re-discovered and renamed vanadium, but its chemical properties were little understood until within the last few years, when an Englishman isolated metallic vanadium for the first time, after a thorough investigation of this element and its salts.

One of its compounds, ammonium vanadate, brought $160 a pound as late as 1871.

Some of Its Properties

Pure vanadium has a specific gravity of 5.5, and its melting point is 3640 degrees Fahrenheit, but it is never obtained pure except in the laboratory, as the expense of purifying prohibits its use commercially. When obtained pure it is a silvery white metal.

The high degree at which it fuses would prohibit its use in steel, but for the recent discovery of the fact, that an alloy of iron, containing from 30 to 40 per cent. of vanadium, has a much lower fusing point than ordinary steel, thus enabling the steel makers to produce an open-hearth steel with vanadium as an alloy.

This discovery was brought about by the fact that vanadium was found to be present in the Swedish and Faeberg irons, which were the softest irons produced at that time, as well as having a ductility that was remarkable. The percentage of vanadium in these irons runs from 0.17 to 0.26 in four pigs, which were examined, but even with this large percentage of vanadium, its ready oxidizability to vanadic acid caused the greater part of the metal to slag off. Thus the slag from blast furnaces working on this metal are rich in vanadium. One test showing a pig with 0.015 per cent. of vanadium, while the slags showed 2.5 per cent. One blast furnace in France treated this slag and obtained from 80 to 100 tons of the oxide per year, which was used for ink making, and in textile works, for the fine black which it produced.

Where It Comes From

The principal sources of the metal, however, are: 1: Vanadinate, which is a mineral containing about 40 per cent. of lead, 12 to 13 per cent. of vanadic oxide, and silica, iron, and silver as the other ingredients. This is obtained in Spain. 2: The vanadiferous sandstones of Colorado. 3: The vanadiferous deposits in South America.

These last two are guarded by a certain amount of secrecy, as they are controlled by one company, which is working under Government patents. We see in this, as in many other things, a product that has taken many individuals over a hundred years to develop, and when it has been developed to a point where it is commercially useful, the developers are dead and some individual steps in, obtains patents, and reaps all the pecuniary benefits from a product that was given to the world by its discoverers and developers.

How It Is Obtained

In obtaining the metal from the ore, the oxide is concentrated and this is reduced in the presence of oxide of iron by the extreme heat of an electric furnace, or by the use of aluminum, both processes being similar and producing a ferro-vanadium of different percentages, as high as 80 per cent. of vanadium having been frequently obtained.

Vanadium is similar to aluminum, both chemically and in its action on steel in producing soundness or making it homogeneous, and it affects steel when applied in extremely small doses. It must be applied properly, however, as it possesses the property of "elusiveness" to a very high degree.

Effect On Tempering

Examination under a microscope shows that it has the power of retarding the segregation of the carbides, which makes the steel easily tempered; this can be done by simply heating to about 1600 degrees Fahrenheit, and quenching in water without re-heating. Under this condition vanadium steel gives considerable elongation, a great resistance to shock stresses, a very high tensile strength and the elastic limit is brought up nearer the tensile strength than any other alloy of steel which I know of.

Some Interesting Tests

This is best shown by one test bar ⅝ of an inch round, which we analyzed and tested. This test bar showed an analysis that it contained:

Vanadium	.268 per cent.
Nickel	2.54 per cent.
Carbon	.156 per cent.
Manganese	.42 per cent.
Phosphorus	.022 per cent.
Sulphur	.028 per cent.

Its physical characteristics in the annealed state were:

Tensile strength, per square inch	85,290 pounds
Elastic limit, per square inch	69,540 pounds
Elongation in 2 inches	34. per cent.
Reduction of area	57.5 per cent.

After heating to 3650 degrees Fahrenheit, which would be a cherry color, and quenching in water, without re-heating, its physical characteristics were:

Tensile strength, per square inch	218,300 pounds
Elastic limit, per square inch	194,820 pounds
Elongation in 2 inches	10.1 per cent.
Reduction of area	18.3 per cent.
Torsional test	1673 degrees
Or 4.77 complete turns before fracture shock stress, Seaton and Jude test	71

Makes Steel Tough

Vanadium also toughens the micro-constituent, ferrite, which shows a close interlocking granular formation, and it is possible to cold-bend square bars of the steel double, which can be done cold without its showing the least sign of fracture.

Its Three Classes

One of the characteristics of vanadium steel is its low carbon content, which is generally from 0.10 to 0.15 per cent., and as they are manufactured today, both in Europe and America, might be placed in three classes, these being: 1, steel containing vanadium only; 2, steel containing vanadium and nickel; 3, steel containing vanadium and chromium.

The first is usually composed of from 0.10 to 0.15 carbon and from 0.15 to 0.25 per cent. vanadium. Vanadium is nearly as powerful as carbon in its effects on steel and should be classed as one of the wonders of applied science, owing to the fact that a few tenths of one per cent. raises

the tensile strength of very pure iron (that, for instance, which is electrolytically deposited) from 5400 to 60,000 or more pounds per square inch, and nowhere in metallurgy or any other branch of applied science do we deal with quantities that are so vast in effect and yet so small in quantity.

Vanadium is being added to carbon steel on account of its producing a ductility of a large degree when added to steel in very small amounts, with the result that it also raises the tensile strength, the elastic limit and its toughness, as shown by bending double.

Another Experiment

An experiment was made by taking a mild steel, low in phosphorus, and adding vanadium of different percentages to it. The following table shows the results obtained:

	Tensile strength in pounds per square inch.	Elastic limit in pounds per square inch.	Elongation in 2 inches.
			per cent.
Mild steel, low in phosphorous ...	60,000	34,400	17
The same, carbonized by melting in graphite crucible.....	62,000	46,000	23
With 0.5% vanadium added, unnealed	94,000	74,000	11
With 1.0% vanadium added, unnealed	138,000	112,000	7.3
With 1.0% vanadium added, annealed	102,000	82,000	18

With 1 per cent. of vanadium added the last steel was very soft but attained great hardness by heating to 3650 degrees Fahrenheit and quenching in water.

This grade of vanadium steel welds as easily as wrought iron, which puts it in a class by itself.

It is generally used for such mechanism as has to withstand vibration. At the same time it is fairly high in tensile strength and elastic limit.

The second class, steel containing vanadium and nickel, is manufactured in several grades and usually contains from 0.2 to 0.4 per cent. of vanadium, with nickel varying from 2 to 6 per cent. These combinations give a tensile strength, per square inch, of from 78,000 to 87,000 pounds, an elastic limit of from 62,000 to 71,000 pounds per square inch and an elongation in 2 inches varying between 30 and 35 per cent. After tempering, without re-heating, the tensile strength raises to 200,000 or 220,000 pounds; the elastic limit from 185,000 to 195,000 pounds and the elongation in 2 inches reduces to, from 10 to 8 per cent.

The Effect of Nickel

Nickel has a peculiar action on steel in that, up to 8 per cent. it renders steel hard, from 8 to 15 per cent. it makes it so brittle that it can be powdered under a hand hammer and its mechanical properties are not readily ascertained by experiment; from 15 to 25 per cent. a rapid rise in extensibility occurs, which increases more slowly after this. Added to a high carbon steel, nickel makes it difficult to harden locally, although it may be oil tempered, and also makes it liable to show "pipes" and "seams." Vanadium, however, makes steel more ductile and homogeneous and therefore when added to nickel steel, a few tenths of one per cent. overcoming the tendency to show "pipes" and "seams," makes it easily tempered, and largely reduces the zone of brittleness which nickel gives to steel, although it is seldom, if ever, used in steel with the nickel component over 8 per cent.

Nickel Steel Resists Shock

Nickel gives steel an ability to withstand shock stresses although the design may be intricate and full of holes, and vanadium adds to this quality as well as raising the tensile strength and bringing the elastic limit up close to it.

This makes a steel that is specially fitted for piston rods, connecting rods, coupling rods, light axles, etc., and while it is not quite up to the standard set by chrome-nickel steel, it is so much easier to machine and temper that many are using it owing to the reduced cost of the finished product.

The difference in tensile strength, elastic limit and shock stress is so slight between these two steels, that it does not warrant the added expense, in working, which is attached to the use of chrome-nickel steel. But for the highest grades of machinery it will be some time before this is replaced.

The Vanadium-chromium Steels

The third class—that is, steel containing vanadium and chromium—is being produced in several different grades, of which the two best known are of the following composition:

Carbon.....	.20	per cent.
Chromium	1.00	"
Vanadium	.20	"
and		
Carbon	.40	"
Chromium	1.00	"
Vanadium	.20	"

The general influence of chromium on steel is to increase the tensile strength and resistance to shock. It also has a tendency to produce a mineral hardness which makes it difficult to work hot, and it is only welded successfully by the aid of electricity owing to the tendency of the chromium to oxidation and the formation of slag.

Cutting Chrome Steel

Two per cent. of chromium added to steel makes it very difficult to cut or machine when cold. The Carnegie Steel Company, after much experimenting, found that about the only way it could successfully cut the chrome-steel armor plates was with a very high speed friction disk. They made a high-speed steel disk about 6 feet in diameter, mounted it the same as a circular saw, and by driving this at a high rate of speed it would wear its way through the armor plates. Plates 6 inches thick were cut on the same principle as a board is cut on a circular saw, except that the saw had no teeth and a stream of water was kept running at the cutting point.

Steels containing chromium only are seldom used for other purposes than armor plate on war vessels, as it seems to withstand the impact of shots better than any other kind of steel.

Vanadium-chrome Steel Cuts Easier

Vanadium added to chrome steel in quantities of from 0.15 to 0.25 per cent. neutralizes this tendency of chromium to produce a mineral hardness and renders the steel comparatively easy to cut and machine. It also raises the tensile strength and at the same time the elastic limit is raised more than the tensile strength is. It also gives steel a remarkable resistance to torsional strains and by the addition of vanadium to chrome steel a steel is produced that is particularly adapted to the manufacture of crank shafts, propeller shafts, railway axles, gears, ball-bearing cups and cones, etc.

Good for Crank Shafts

The fact that vanadium gives steel a high degree of ductility and at the same time increases its tensile strength and elastic limit, makes it one of the best of steels for crank shafts for multiple cylinder internal-combustion engines, owing to the intense strains which they have to stand from the explosion. As this steel can be bent double without showing signs of cracks a crank shaft can be bent to shape, out of a solid bar, thus making the grain of the steel follow the shape of the crank. After bending, it should be annealed in order to remove any internal strains.

This would make a stronger crank shaft than one forged in a slab and then slotted out, as well as effect a great saving in material.

Where it Would Save Stock

As for instance a six-throw crank shaft worked out of the slab weighs when finished 72 pounds—in one instance that I know of—while the slab before it is operated on weighs 360 pounds. This is where the crank shaft is made out of a very high grade of steel, but one that will not stand bending as will vanadium steel. The best results with this steel are obtained by working it out of the slab, but at the same time what little grain there is to the metal is cross grain in several places in the shaft.

The vanadium steel, bent bar, would

weigh about 175 pounds for a finished crank weighing 72 pounds, thus saving about one-half in the material used.

In the automobile business in Europe this steel is fast coming into use for motor-car engines, as a compact light and powerful car is the ideal aimed at and demanded.

Tests of Chromium-vanadium Steel

The results of chromium and vanadium added to steel are best shown by the following table:

	Tensile strength in pounds per square inch.	Elastic limit in pounds per square inch.	Reduction of area.	Elongation in 2 inches.
			per cent.	per cent.
Carbon-manganese steel (plain)	56,000	34,000	60	35
The same plus 0.5 per cent. chromium	72,000	46,000	61	33
The same plus 1.0 per cent. chromium	80,000	52,000	57	30
The same plus 0.10 per cent. vanadium	72,000	60,000	60	31
The same plus 0.15 per cent. vanadium	76,000	64,000	59	26
The same plus 0.25 per cent. vanadium	82,000	72,000	59	24
The same plus 1.0 per cent. chromium and 0.15 vanadium.	102,000	76,000	57	24
The same plus 1.0 per cent. chromium and 0.25 vanadium.	128,000	104,000	46	19
The same plus 1.0 per cent. chromium and 0.15 vanadium, hardened.	178,000	148,000	48	16
The same plus 1.0 per cent. chromium and 0.25 vanadiam, hardened.	202,000	188,000	45	12

These tests were made from crucible steel and to them should be added a torsional and shock test as the tendency in the past few years has been to raise the tensile strength with the result that static ductility has been sacrificed and when used on machinery which had to stand high shock stresses or torsional strains as in the modern automobile, sudden fracture was the result. The breaking of crank shafts in boats and axles on railroads has also been due to a brittleness in steel that was high in tensile strength and elastic limit and showed a good elongation, but at the same time the brittleness did not show itself until submitted to the shock and torsional tests of actual use.

Used in Malleable Iron

Vanadium has also been used in malleable iron with good results and many different combinations of vanadium and other alloys are used, in steel for different purposes. One combination—other than those described—is said to make excellent material for springs and another is claimed to be a very high-grade tool steel. The properties it impresses upon steel may be said to lie between carbon and chromium.

Much Yet to be Learned

In conclusion I might say that vanadium steel being of such recent origin much is yet to be learned of its good or bad qualities, as for instance we do not know the extent to which it may be forged, hardened or machined and also what its wearing qualities are. The tests given vanadium steel have mostly been experimental and laboratory tests, and these show quite conclusively that it is excelled only by nickel-chrome steel and for some purposes may be as good as that, although it would be a difficult proposition for it to show better wearing qualities for gears than nickel-chrome steel. But the future may bring developments that will improve on the present quality. From the present outlook, based on what is known of it, it is liable to replace and exclude nickel, tungsten and molybdenum steels.

Backing-off Formed Cutters in the Milling Machine

By M. B. Stauffer

The grooving of chilled-iron rolls for flour mills involves the use of special formed tools. These special tools are serrated on the edge, according to the number of teeth or corrugations to be cut on the roll. The teeth of the tool are also made on an arc of a circle to conform to the roll, and thus have a maximum width of tool operating on the work. Since it is not practicable to take a chip over 0.005 inch deep at one cut, it is again desirable to have a wide tool face. The advanced teeth are ground down so as to avoid a heavy chip, while the following teeth are deeper until full depth is reached. The cutting tool is set so that the bases of the teeth conform with the arc of the roll.

The teeth on these tools range in pitch from 1/6 inch to 1/64 inch, so it will be appreciated that great accuracy is imperative. The accuracy required is not so much in the number of teeth to the inch but in the spacing. The old style of cutters could easily be made in an engine lathe, using the proper gear for spacing the teeth. This method gives no relief, however, to the teeth, unless a backing-off attachment is used. This was not the rule in old-style cutters of straight face. The advent of the new tools presented more difficult conditions of manufacture. The teeth, being on the arc of a circle, could not be spaced accurately on a lathe with ordinary tools.

In making these tools I take a milling machine with a circular attachment, on which I mount an auxiliary slide carrying a tool post. The cutter-blank is mounted on the arbor of the machine, and also a backing-off cam.

Before backing off, of course, the blanks are bored, rough turned, gashed and key-seated. The key-seat must be properly located in relation to the teeth to match with the cam. The nut on the screw of the milling-machine table is disengaged and a weight attached to keep the cam stop against the cam. The circular attachment is set at first with a turning-tool point, so that it will just take a truing-up cut over the blank. The lands will be relieved at the same time. The proper shaped forming tool is now inserted in the tool post and the first tooth cut to the proper depth, and the stop set to insure uniformity of depth. The indexing is done by the graduated dial on the worm shaft.

This method of making does not give ideal backing off, but these cutters answer every requirement. The cutters can be polished in the lathe by running them backward at a moderate speed. Another cut should be taken through the flutes to avoid excessive grinding after hardening. Care must be exercised in heating these cutters so that a uniform heat is obtained. They should be hardened in oil and need not be drawn. After lapping the hole and grinding the teeth, the cutter is ready for use. It can be sharpened indefinitely without changing its form.

Cementing Leather to Iron

It is often necessary to cement leather to iron rollers, etc., used in the textile and other industries.

Where it is possible to heat the iron shellac is perhaps as good as anything else. The iron should be thoroughly cleaned, care being taken that there is no grease or oil on the surface. Common orange shellac is dissolved in spirit and applied to the roll. The shellac should be as thick as very thick molasses and the roll should be slightly warmed. A thin coat of shellac should be applied to the leather and the leather clamped or otherwise held in the position it is to occupy on the iron. For flat work clamps or weights are all right for holding the leather in place, but on work such as rolls other means have to be employed. Rope or string can be wound tightly around the leather after it is in place on the roll. If the roll can be mounted in the lathe while being covered, so much the better, as the shellac can be applied better and easier and the rope can be wound more uniformly both as regards position and tension.

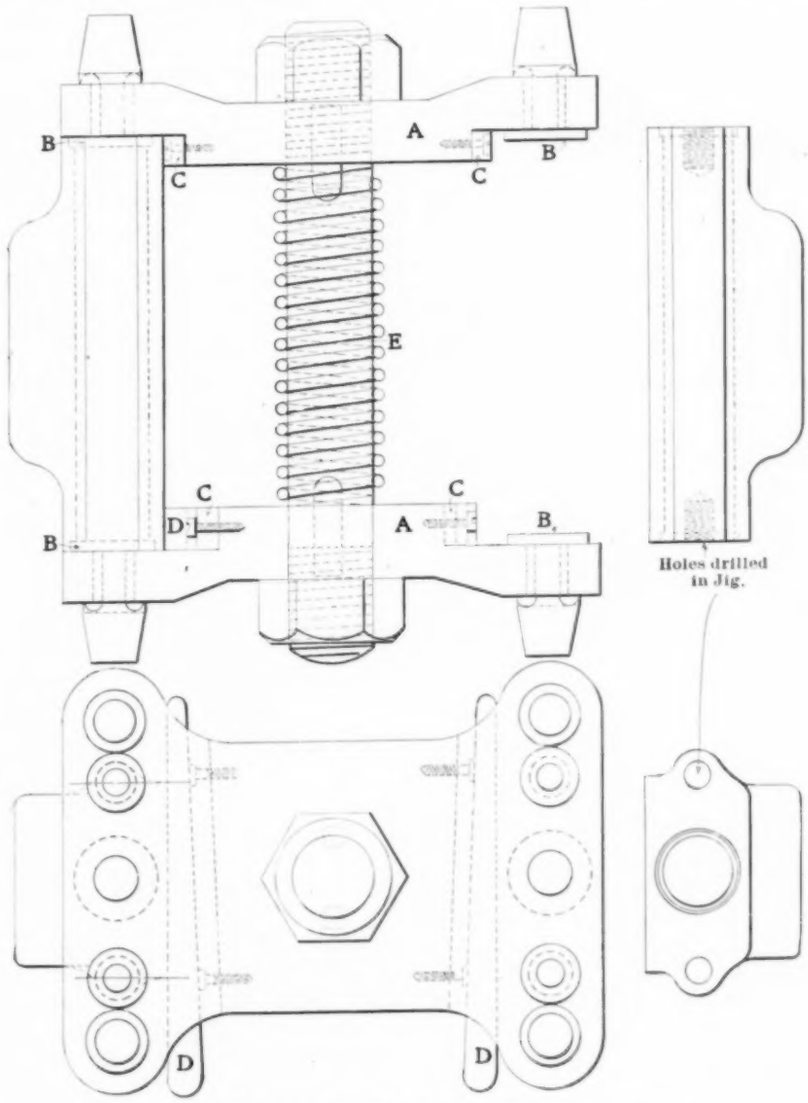
Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Drilling Jig for Cover-stud Holes in a Rock-drill Steam Chest

The manner in which the steam chest castings are held in the jig is, I think, a little unusual, yet it is quite simple.



A DRILL JIG FOR STUD HOLES IN A ROCK-DRILL STEAM CHEST

The drawing needs little explanation. It shows the jig with the work in place on one side. The plates *A* are of cast iron. They contain the drill bushings and on their inner faces have hardened tool-steel disks *B* made to fit the counterbore in the chests. These disks locate the work.

At *C* are hardened tool-steel stops against which the finished side of the work bears at the top as shown in the cut, and against which the wedges *D* bear at the bottom. The wedge *D* squares the work if there is any play between it and the stop *C*.

The plates *A* are a neat sliding fit on the keys of the center bolt *E*. The spring around this bolt spreads the plates when the nut is backed off. One turn of the nut is sufficient to separate the plates and allow work to be put in or taken out.

After one end of a pair of chests is drilled the jig is turned over to drill the other end and when that drilling is finished the chests are removed and others put in without turning the jig back to its first position.

The jig saved me considerable time over the methods formerly in use and I think the idea may be applicable to other work.

H. G. BREHAUT.

Steam-engine Valves and the Steam Turbine

Shop Talk About Steam Engines, page 468, has interested me, yet I do not like the position of the writer in talking very discouragingly of the steam turbine.

The wastefulness of reciprocating engines is a known fact as well as valve leakage, particularly in unbalanced slide valves. Of course, the balanced valves have material advantages as they are protected from undue pressure. Yet there is no denying the fact that any surface having a reciprocating motion, be it flat or cylindrical, is bound to wear unequally. As for the Corliss valve, which has nothing more nor less than a reciprocating rotary motion, I would say "there is no perhaps about it," it is the easiest type of valve to get out of order from wear, and again, poppet valves which were used principally for slow speeds on steamers and in heavy-duty rolling-mill service, are tight and most reliable against leakage, yet they have their shortcomings. Mr. Crawford seems to make the poppet valve the peer of them all, and while we have a number of good and durable balanced poppets in use, even they have their disadvantages. This age is progressive, however, and Mr. Crawford says but little on the broad subject of engines.

I do not propose to discard my good old friends the present reciprocating engines which have served me so well, and are still performing their important functions, yet I do not wonder at the advent of the steam turbine. Something better is needed, something which will get rid of the enormous wastes of our present methods. Our present type of prime movers has served us for nearly a century, and has contributed greatly to the mechanical success of this and all other countries. Still we are looking for something better. A rotating prime mover is wanted, and while we have had failures by the thousand and only a few successes, its coming is certainly just before us. I am not a rotary crank, but I have always maintained and believe that a rotating prime mover is the coming source of power.

Thus far it has not been developed, but the demands from all quarters for electric

generators, for mechanical power, for automobiles are so insistent that it is no wonder that the present experimenting with steam turbines is being pushed with vigor. HERMAN FLETCHER.

Cement Patterns for Metal-pattern Castings

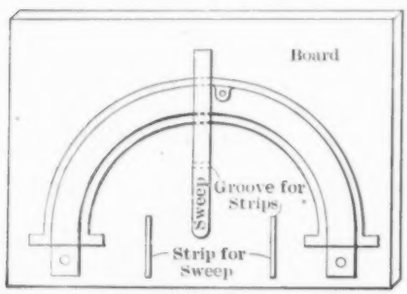
A cheap way of making iron patterns and core boxes for large or small cast-iron elbows or curved pipes is to sweep them up in close-grained cement. The method of using the sweep is shown by the cut.

The core box is preferably made as a half box, with the diameter of the outside sweep ¾ inch larger than the inside one, so as to give a cement shell ⅜ inch thick. After the shell is dry it is placed on a level board and varnished thoroughly both inside and out. This gives a good, clean pattern for the core box.

In making the cement shell pattern for the metal pattern itself, I use the core-box cement shell and a sweep 1½ inches larger in diameter than the inside of the shell. This gives a casting from the metal pattern ¾ inch thick.

Over the cement shell are set wooden flanges in the proper locations. The pattern sweep is used between these flanges. In this manner the cement-shell pattern is formed and, after drying, is finished with a coat of varnish.

The molding for the iron pattern is carefully done, a core being swept up from sand so as to leave about 5/16 inch for the thickness of the metal. Lugs are cast on the inside for steady pins.



CEMENT PATTERNS FOR METAL PATTERNS

The castings made in this way are smooth and true and can be easily finished for metal patterns.

The work of making the patterns is done by the patternmaker, not by the molder, as in making sand patterns.

The cement pattern for this class of work is the cheapest which I have used, being smooth, easily molded, and giving a smooth metal-pattern casting of uniform thickness and general satisfaction.

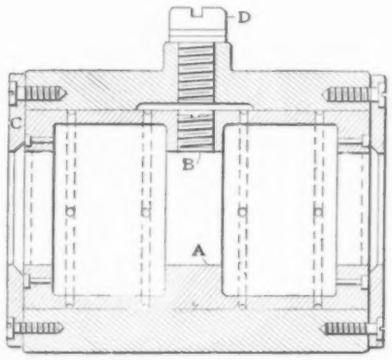
In regard to the cement mixture, it need not be all cement, but can be filled in with small blocks such as are found in any pattern shop. H. C. BLUM.

253 Pike street, Cincinnati, O.

Arrangement of Tight and Loose Pulleys

I notice that Herman Fletcher takes some exceptions at page 458 to the arrangement of tight and loose pulleys shown at page 295, illustrating the practice of the Brown & Sharpe Manufacturing Company as shown at the Exposition of Safety Devices.

Mr. Fletcher evidently assumes that the pulleys shown are of the kind where the loose pulley runs directly on the shaft. These have not been used for some time on the counter-shafts of machines made by this company.



SELF-OILING PULLEY

For many years the Brown & Sharpe Company has provided the hangers for the counter-shafts with self-oiling bearings requiring a new supply of oil but once in about six months and for some time past the loose pulleys have also been provided with self-oiling bearings.

The accompanying sketch shows the hub of a loose pulley of the style such as is now used.

Referring to the illustration, the bronze bushing *A* is made fast to the shaft by the set screw *B* and is so positioned that the washer *C* will clear the hub of the tight pulley. It will be seen that this construction requires no collars. Any oil that works out from the ends of the bearings is returned by means of the chamfer in the end washers and the holes shown in the bushing and again put into use to oil the bearings. When a new supply of oil is required, the screw *D* is removed and the oil chambers filled. Leather washers under the head of this screw prevent the leaking of the oil.

It is considered that the use of this improved bearing not only saves time in oiling and avoids wear such as to require rebabbitting but that it, as well as the self-oiling hanger, serves the purpose of a safety device, in that the workman is required to do the oiling only once in a number of months enstead of every day, thus minimizing the danger necessarily attending such work.

LUTHER D. BURLINGAME.

Calculating the Radius of an Arc for a Given Span and Rise

When it is desired to get the radius of an arc of a circle of a given rise and span, the most convenient method for small circles is probably the method given in geometrical problems for making a circle pass through three given points, by bisecting with compasses the lines, real or imaginary, connecting the points, the intersection of the bisecting lines giving the required center. The three given points in this case would of course be at the ends of the given span and rise.

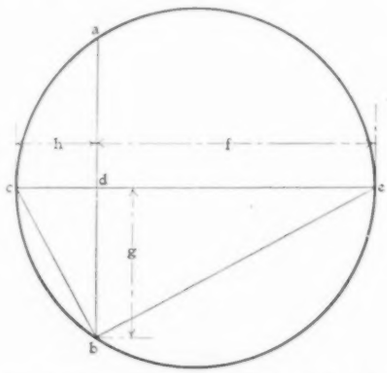
If, however, the given span and rise make the circle a large one, the radius may be more conveniently and accurately calculated by the following rule, which, though not original with me, I have never seen in print anywhere.

To get the radius of an arc of a circle when the span and rise are given:

Rule—Divide the square of one-half of the span by the rise, add the rise, and divide by 2.

Example—Required the radius of an arc 12 feet span and 2 feet rise. One-half the span equals 6 feet. The square of 6 is 36. Dividing this by the rise gives 18. Adding the rise makes 20. Dividing this by 2 gives 10 feet as the required radius.

The reason for the rule may be shown as follows, reference being had to the accompanying illustration, in which *a b* is the given span of the arc *a c b* and *c d* the



CALCULATING THE RADIUS OF AN ARC FOR A GIVEN SPAN AND RISE

rise. Inasmuch as any angle formed within a half circle, having its apex touching the circumference and having its sides touching the ends of the diameter, is a right angle, the angle *b* of the triangle *c b e* is a right angle. (It is on this principle that a patternmaker tests with a try-square a core box which he is working out by hand.) Then the two smaller triangles *b c d* and *b d e* are similar to the large triangle, as they each have a right angle, and each has an angle in common with the large triangle. Being similar to the large triangle, they are similar to each other, and their corresponding sides will have the same ratio. Letting the letters

f, g and h represent respectively the lines $d\ e$, $d\ b$ and $c\ d$, we have the proportion:

(1) $f : g = g : h$

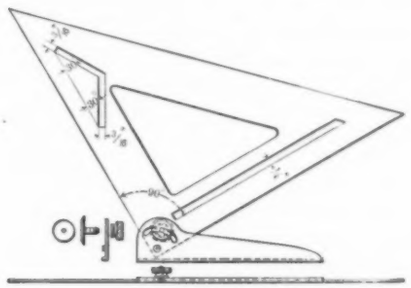
(2) $f h = g^2$

(3) $f = \frac{g^2}{h}$.

But g equals half the span of the given arc and h equals its rise, so that the length of f, the remainder of the diameter of which h is a part, equals the square of half the span divided by the rise; and f + the rise h, divided by 2, gives of course the required radius. F. L. S.

A Triangle and Attachment for Angle Work

It is sometimes difficult to draw unusual angles with the ordinary draftsman's tools. A part of this difficulty is, to be sure, overcome by the shifting head of the T-square, yet I find that the lower right-hand corner of the paper cannot be



A TRIANGLE AND ATTACHMENT

covered by the T-square without moving the paper or having a long strip attached to the left-hand edge of the board to give a bearing for the T-square head.

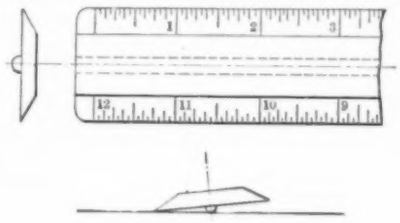
I made the device shown in the accompanying cut to cover these conditions. A piece of sheet tool steel 1/32 inch thick, has a lip turned down and filed straight to act as an edge to rest against the T-square. Into this is riveted a stud which acts as a fulcrum for the triangle. A slot is formed for the adjusting screw. This holder is then attached to a triangle as shown. A long slot is in the triangle at an angle of 90 degrees with one side and parallel to the other and gives a ruling edge. The 3/16-inch slots at the other end with their sides at an angle of 30 degrees with the adjacent side of the triangle can be used to advantage in drawing the plan view of hexagonal screw heads.

Angles of 120, 75, 60, 30, and 15 degrees can be obtained from these 3/16-inch slots by placing the triangle in different positions.

The device has proved very serviceable to me and may help some fellow draftsman. C. STANTON BARBER.

Improving the Draftsman's Scale

I had an ordinary 12-inch scale which lay flat on the table and was always a bother when I tried to get hold of it to pick it up. Scraping a little shellac off the center of the full length of the scale so that glue would stick, I glued a small strip of wood about 1/16 inch thick and ⅛



A SCALE IMPROVEMENT

inch wide along the back as shown in the sketch herewith, and now I think as much of this scale as of any that I ever used. This is so simple a scheme that I do not know why it has not been tried before. Perhaps it has but if so I have never happened to see it. H. E. SEAVER.

Turning Locomotive Piston Rings

The illustrations show tools which are being used for machining piston rings for locomotives. The rings are cast in blanks 12 inches long, and are turned and bored simultaneously, with the tool shown in Fig. 1. They are then cut off with the tool Fig. 2, leaving 1/32-inch for finishing the sides, which is done on expanding mandrels with a straddle tool. The body A of the cutting-off tool is of machinery steel, having a shank to fit the tool-post.

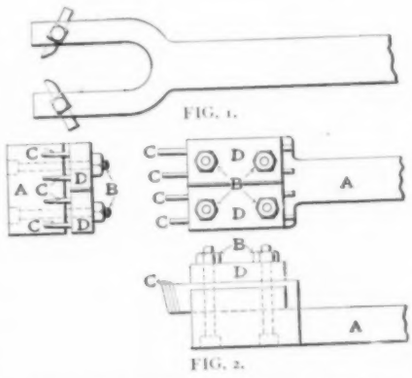


FIG. 1.

FIG. 2.

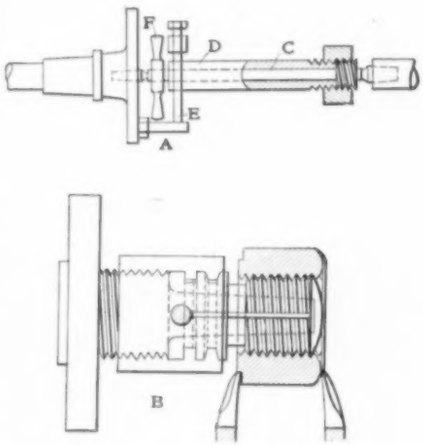
TURNING LOCOMOTIVE PISTON RINGS

B are ½-inch bolts. C are cutters, of high-speed steel, nicely fitted into the slots in the body A. D are clamps for tightening the cutters, one clamp resting on two cutters. The number of cutters is limited only by the belt power and rigidity of the lathe. By using this outfit the time required to do the machining is greatly reduced. HARRY.

Arbors for Squaring Nuts

To avoid unequal tension in the thread, it is desirable that the faces of nuts be turned off exactly at right angles to the axis of the thread, but if a nut is screwed on an arbor so that it bears tightly against a collar, and the thread is not very exact, the face is apt to be oblique to the axis.

At A is shown a device described by A. Johnan in the "Zeitschrift fur Werkzeugmaschinen und Werkzeuge," used to obtain a perfectly true nut face. The thread on which the nut is screwed is partly on the arbor itself and partly on a tube D which surrounds it or, to put it in another way, the arbor is hollow, and has one part of the thread to take the nut, the other part being on a cylindrical core which fits it exactly. The tubular part of the mandrel carries the dog E, while the core is furnished with a small handwheel F. If the tube be turned against the direction of the thread of the man-



ARBORS FOR SQUARING NUTS

drel C the nut will be held tight enough on the threads of both C and D to enable it to be squared on both faces. When the work is done, the hand-wheel F is turned back to loosen the nut.

In another device, shown at B and from the same source, the arbor has a thread fitting that of the nut, a conical hole, and is made to expand by virtue of three lengthwise slits. A conical plug is fast in the lathe spindle and the parts of the arbor slip over it.

A spanner nut which has a ring groove fitting corresponding projections on the three parts of the arbor is screwed on the lathe spindle. This can be adjusted lengthwise over the conical plug.

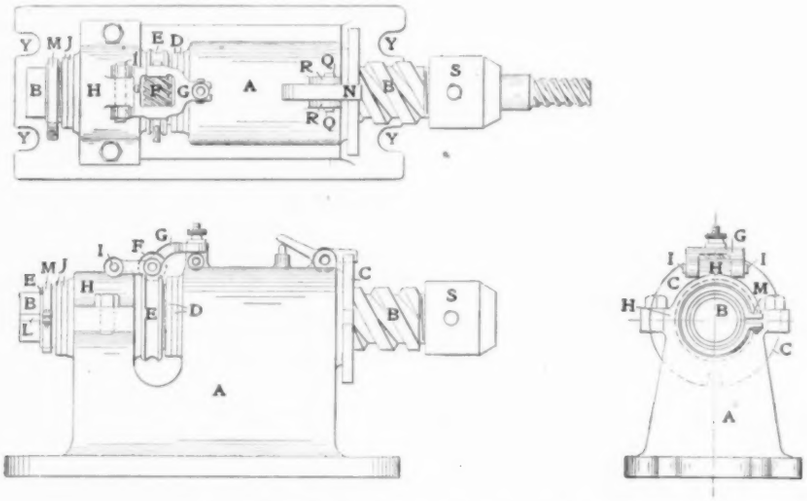
In using the device, the nut which is to be squared is screwed by hand on the three-part arbor then by turning the spanner nut the arbor is expanded and grips tight in the nut thread. Both faces of the nut can be squared. In order to insure perfect work, the nut threads are milled out as shown, so that the squaring

tools do not cut into them. When the nut is finished a half turn of the spanner nut will free it from the arbor.

ROBERT GRIMSHAW.

Cutting Quadruple Threads

In a shop where I was recently employed I happened to notice a fellow workman cutting a quadruple screw, cutting all the threads simultaneously.



FIXTURE FOR CUTTING QUADRUPLE THREADS

Fig. 2 *A* is the forged body in which the slot is milled to receive cutter *B*, which is made with proper rake to clear the thread on the front edge of the cutters and angled at the back the same degree as the wedge. A hole is drilled through an easy fit for the bolt *D*. The wedge *C* keeps the cutter square and solid. The bolt *D* goes right through both body and tool, clamping with the nut.

The tool was used with great success. The screws were made in pairs. I do not remember the dimensions, but should say about 2½ inches diameter by 8 inches long on the threaded part. Fig. 1 shows the work; of course, the tool ran across and clear of the work. After the screw was cut to size it was parted through the middle, leaving two 4-start screws cut just under 40 minutes, which certainly is "going some." B. P.

Tool Buying Club

The letter of Carl Armerding, entitled "A Tool-buying Club," which appeared at page 496, calls to mind a system that was in force at the shops of the Corbin Motor Vehicle Corporation at the time I was employed with them, which it might be well for other employers to emulate.

They purchased all their tools through one hardware house, who, in order to hold this business, allowed them a discount. The company, in turn, placed a lot of small tools, such as hammers, wrenches and screw drivers, in their stock room, which could be purchased by the men at cost.

The more expensive tools, such as micrometers, verniers, etc., they would order for the men on application to the foreman toolmaker, and when the tools were delivered, arrangements could be made at the office on request to have the cost taken out of a man's pay in reasonable weekly amounts.

Inasmuch as the discount on tools varies between wide limits, depending on the maker and the dealer, this method represented quite a saving as well as an accommodation when the tool chanced to be a 12-inch vernier or a hight gage, as the firm can generally get a better price owing to large amount of supplies bought.

L. L. ARNOLD.

Another Piston-ring Mandrel

The description of H. E. R. Manbrand's piston-ring mandrel at page 286 has led me to think that the mandrel for closing and grinding, shown in Figs. 1 to 3, might prove of interest. All the parts are made of machinery steel, *S* being case-hardened.

The rings *R* are bored, rough turned, and cut off 1/64 inch too wide, after which they are ground to correct width on magnetic chuck, then sawed, grooved and tongue pieces *C* fitted. Now comes what is generally the most tedious operation, i.e., closing, setting, and turning or grinding to correct diameter, but one which may be speedily accomplished with the aid of this tool.

Fig. 1 shows the mandrel complete, Fig. 2 a longitudinal section, while Fig. 3 shows it cleared for action. Fig. 2 shows pretty clearly how it is used. The ring *R*, with tongue piece in position, is held lightly between the face *E* on mandrel *M*, and the flange *F* by means of nut *T*. Coned sleeve *S* is now forced against *R* by turning nut *N*. This brings the ring into the position shown in Fig. 3. Nut *T* is then tightened and at the same time *N* is eased back and is finally taken off, together with coned sleeve *S*, leaving a clear patch for tool or grinding wheel as may be seen in Fig. 3.

In addition to the usual allowance for splitting, the rings should be left 1/64 inch large on outside diameter when rough turned. I have found it necessary to leave them considerably larger than this when a flexible band has been used for closing in. H. G. W. BASINGSTOKE.

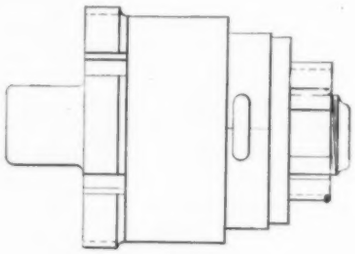


FIG. 1

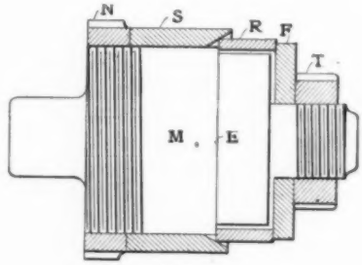


FIG. 2

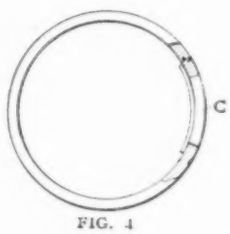


FIG. 4

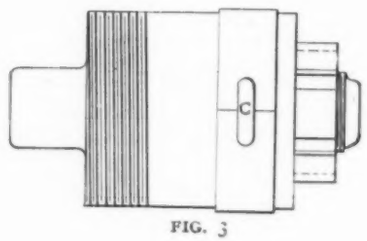


FIG. 3

A PISTON-RING MANDREL

Winding Large Magnets by Electric Motor

I am tempted by the article on page 260 to send a description of how a winding job was done under rather difficult circumstances.

The job was the winding of a large magnet which was used in connection with a magnetic separator on a coal-crushing plant. There were no convenient means at hand for winding this except fixing a crank on the spindle and having a boy to turn, which, however, was out of the question, as this magnet had 15 spools with 70 pounds of No. 18 wire on each, which, to say the least, would be rather hard on the boy. This, moreover, would have been too slow, as the job was wanted in a hurry. Of course we could have put the job in the lathe, but as our lathe was too busy, that was not to be thought of.

We rigged up the magnet on a pair of trestles, as shown in Fig. 1, and fixed a split wooden pulley on the end of the spindle and arranged to drive with a motor. To get the necessary speed reduction we ran the belt directly on the motor spindle, around which a bit of insulating tape was wrapped to prevent the keyway from cutting the belt, and also to help the driving. The belt was run a little slack so as to allow a little slip.

A Device for Stopping Quickly

An old switch was unearthed and rigged up to work with a treadle operated by the foot, as shown at *S*, Fig. 1, this giving the operator perfect control over the starting and stopping. The switch was connected up to the motor as shown in Fig. 2. The current was switched straight on to the shunt field of the motor, and the switch was interposed between the line and armature. A resistance of about 8 ohms was put in series with the armature, on the line side of the switch, which prevented excessive rushes of current on switching on. As clearly shown in Fig. 2, with the switch in the "on" position, the resistance and armature were in series and connected across the line, and with the switch in the "off" position, the circuit for the line current through the resistance and armature was broken and the armature was short-circuited through the switch.

This short circuit on the armature with the field full on gave such a powerful braking effect as to pull the motor up dead. The switch, on again being depressed with the foot, started the motor instantly. This rig enabled us to do this job in about a quarter of the time and far more conveniently than would have been possible by any other means at our disposal.

FRANK SAWFORD.

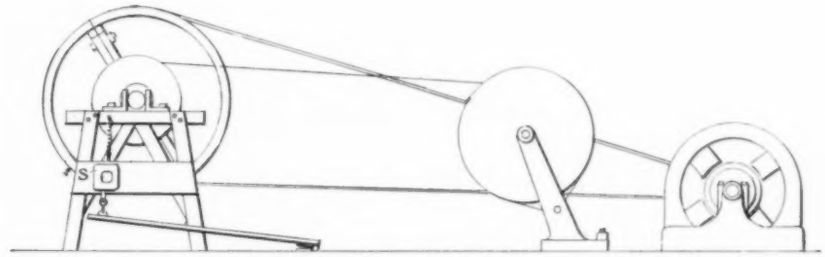
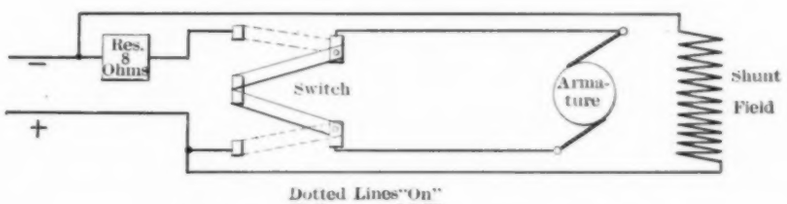


FIG. 1 Winding Large Magnets by Electric Motor

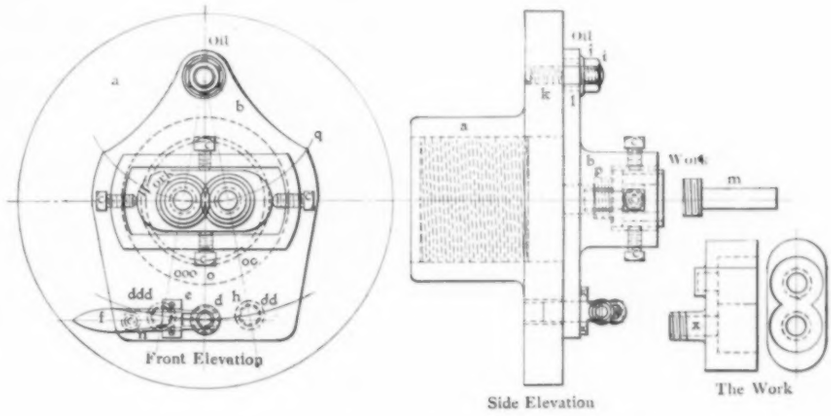


Dotted Lines "On"
Full " "Off"

FIG. 2 Short-Circuiting Arrangement for Stopping Quickly

A Fixture to Machine Geared Pump Cases

The accompanying drawing shows a fixture to machine geared pump cases. We had a contract to fit up five hundred of these. We faced off twenty-five of the cases in the lathe and counterbored them in a jig on the drill press. After doing this we found they were not counterbored square with the face. After so much being done for nothing, I was asked if I could make anything to do them in. So I designed and made the fixture for the turret lathe I am showing in the accompanying drawing.



THE FIXTURES FOR MACHINING GEARED PUMP CASES

The body *a* is of gray iron, the hub bored and threaded to fit the spindle in the turret lathe. It is faced off and turned off, being left large enough to have ample room to attach part *b*, also of gray iron. *b* is planed off on the back and a portion of each end on the front, where the binding stud and latch and pin are located. The bottom of part *b* is made wide enough to cover the holes *d, dd, ddd,* when swinging from one to the other, to protect them from dirt. Part *b* is raised in the center and chambered out, or it can be cored out when cast, to receive the work and to allow the projections on the pump case to clear, so that the case can rest squarely on the bottom. The hole that receives the projection *x* for the driving shaft is bored and threaded to receive stud *m*.

In the front elevation it will be seen how the locating holes are laid out. The hole for the binding stud *k* is laid out first, getting it far enough away from the center so as not to have too small a radius *q;* then the lines *o, oo, ooo* are drawn. Their position is governed by the size of the gears used. The index holes *d, dd, ddd* are far enough below the center to have ample room to operate the latch pin *h*. These holes are bushed. The holes in the bushings and the end of the latch pin are tapered, so that the spring under the latch will press the pin into the bushing and

hold it very rigid. Part *b* is held by and wings on the stud *k*. There is a hardened tool-steel bushing in *b* to receive the stud *k*. The nut *i* and washer *j* bind *a* and *b* together. I do not show any detail drawing of the latch and pin; it is similar to the latch on a lathe to reverse the feed.

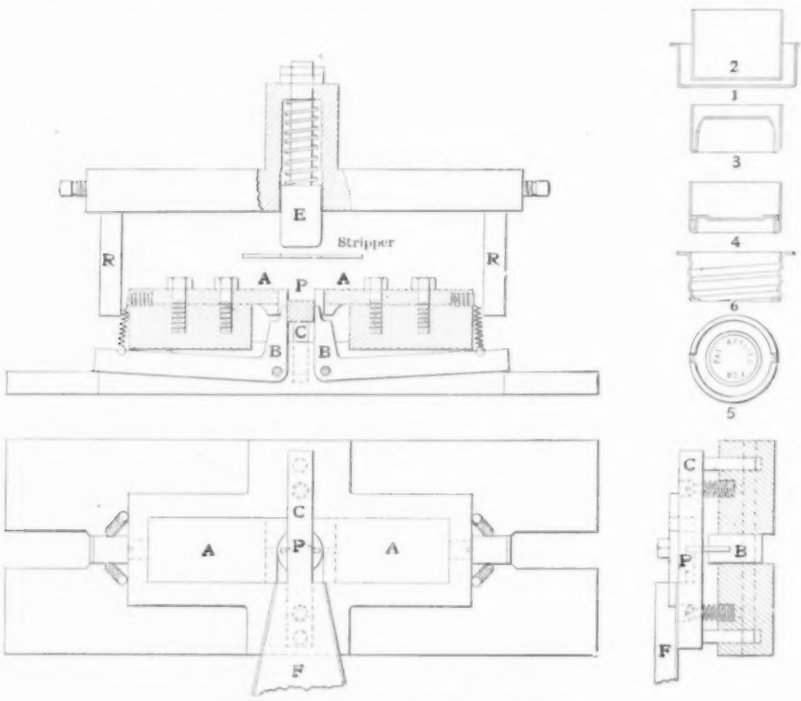
Four binding screws are provided in *b* to hold the work in position *cccc*. After the case has been located and bound by the screws, the latch pin is in the center hole; the case is then faced off, having a set of tools arranged in the turret head to counterbore for the gears and drill and ream for the driving shaft and stud. This done, the latch pin is released and the body *b* is swung so as to engage the pin with either hole *dd* or *ddd* and counterbore for the gears and back to counterbore for the other. It is only necessary to loosen two of the binding screws to take the work out, always using the same two, leaving the others to locate the work in position. After these operations have been done on all the cases, screw the stud *m* into the threaded part of *b* at *p*, the end of this stud being a nice fit for the hole in the projection where the driving shaft goes through; reverse the case and slide it over the stud *m* and bind it with the binding screws. With a hollow mill and die you can machine and thread the end of the projection for the stuffing box. Then by fitting a block into the chamber in *b* and providing another set of binding screws you can face off the cover for the case, doing all the operations on both case and cover in this one fixture.

OREL B. FRENCH.

Greene, Chenango Co., N. Y.

Punch and Die for Notching a Screw Cap

The evolution of a patented screw cap, such as is used on coffee flasks, paint cans and jelly jars, is shown in the sketch, with the tools for the notching operation, the subject of the patent. The first operation is an ordinary cap draw No. 1, with a flange for trimming; No. 2 is a redraw and trim that was treated of in a former article. Both these might be combined in a double-action press, but would leave a slow rotary trimming operation, as tin plate runs high and low on two draws. No. 3 is an inverted redraw which delivers enough stock to the inside of the cup to make the fourth operation possible, that of smashing down, embossing and stamping the "Pat. applied for," the shape of the tools for Nos. 3 and 4 is apparent from the outlines. No. 5 is our main study; the cutting of the two notches about ⅛ inch wide and deep, for the insertion of a knife blade or spoon handle as a lever to loosen the cap. The final operation is the thread rolling, the cap and nozzle No. 6 being placed together and rolled in a regular threader. The nozzle is rather a plain job.



THE WORK AND THE PUNCH AND DIE

The notcher is of the self-contained punch and die type, the punches being a part of the die proper, the ram motion serving to actuate them and also to locate and pick up the work. The cutting portions of the die *A* conform partially to the shape or diameter of the cap so as not to distort the metal in the cutting; and a portion of each is cut away, giving a straight runway to the work, so that it can drop in place, as seen in the plan. The cutting punches *P* are carried in the levers *B* working on pins and actuated by pushers *R* and carried back to position by springs.

The bar *C* acts both as a slide for the caps and as a stop for the depth of notch, as will be understood when following the line of action; it is guided by two pins and raised by springs, its upward motion being limited by screws passing through the springs. The plunger *E* acts as a pick-up and is a fit to the inside of the cap, which is then stripped from *E* and drops down.

Following a cap like No. 4 on its journey from the chute *F*, it will slide on the bar *C*, which is set high enough for the cap to clear the punches and locates itself approximately. By the descent of the ram, the pick-up *E* enters the cup, bottoms in it and forces the cup down into the circular recess provided for it and over the cutting punches, the bar *C* of course descending with it, the springs being weaker than that behind *E*. When the guide pins of *C* bottom in their holes the depth of notch is reached; further motion of the ram is taken up by the spring behind *E*. About this time the pushers begin their work on the punch levers and on the up stroke the cup follows the pick-up and is stripped from it, falling into a box, the press being inclined. Small chutes fitted under the cutting edges carry off the scrap punchings. By virtue of their shape two caps cannot get in the die at once unless the stripper fails, and this permits feeding as fast as the press can be stepped off. As there is little chance of shearing, repairs are few and inexpensive. The cut edges are hardened; the punches are of unannealed steel.

SIRIUS.

Making Large Blanks Without a Die

I once had the job, without blanking dies, of shaping irregular blanks out of sheet or plate, so as to be nearly duplicates. Blanking dies were out of the question on account of the large dimensions of the blanks and the cost.

A regular one-inch punch and die were used, the die projecting about a quarter of an inch above the die block. A templet of quarter-inch plate was filed up for each shape, but as much smaller all around as the distance from the outer edge of the die to the edge of the hole in the die.

With a templet clamped to the stock, and with the templet below against the outer edge of the die, the punch will bite off small pieces of the same shape as the templet. If two big bites are taken, the edge will be very jagged, but by taking a little care it will be smooth enough so it can easily be ground to shape.

A. D. KNANEL.

Diagrams versus Formulas

Your editorial on page 542, "Diagrams versus Formulas," is one of many proofs how little, after all, the main object behind the experiments described in Mr. Taylor's paper "On the Art of Cutting Metals" has been understood, and as practically every diagram and formula presented in that paper are my personal contribution as one of Mr. Taylor's associates in his work, I feel your editorial to be a reflection on my own common sense; as I am very jealous of this latter, I shall take the liberty to try to show you how little you have penetrated into the spirit of the whole paper.

The object Mr. Taylor had in view when he first set out to experiment on cutting pressures, feeds, speeds, etc., may be stated as an attempt to discover a method of predetermining the proper way of utilizing at the same time the full pulling power of a machine, such as a lathe, and the full efficiency of its cutting tool, in rough-machining a piece of work; when I joined him in Bethlehem in the summer of 1899, he and his associates had already advanced far enough to have some of their experiments embodied on a crude slide rule, by means of which, and some cutting and trying, that feed and speed of a lathe that would rough-turn a piece of work in a minimum of time could be approximately determined.

When Mr. Taylor turned the supervision of his further experiments and the mathematical investigations connected with the work over to me, I soon recognized that the way to handle the proposition was as follows:

First, to plot the results of a series of experiments, then roughly to sketch on the plot a series of curves to cover them as nearly as possible, and finally to construct an empirical formula to represent these curves, *this formula necessarily to be of a form that could easily be embodied on a slide rule*. And here is the point, for neither the diagrams nor the formulas were meant to be for any practical use whatsoever in themselves, but merely the means to an end; and that end is the slide rules so frequently referred to in Mr. Taylor's paper that there is no excuse for the criticism made in your editorial herein referred to. Besides, my own paper on "Slide Rules in the Machine Shop, as a Part of the Taylor System of Management," read before the American Society of Mechanical Engineers, December, 1903, merely mentions the existence of the formulas embodied on the slide rules described, thus showing that we never had in mind any other use of them than their incorporation on those rules.

CARL G. BARTH.

An editorial on page 542 has it "Diagrams versus Formulas," and then proceeds to a justification of the form of the title by showing the greater handiness of the diagram, as compared with the formula, and from that proceeds to argue that it is ridiculous to use a diagram for the development of a formula.

From the ground so prepared, even from the inception of the title, no fault can be found with the conclusions arrived at. The basis, however, is wrong. There is no, and there should be no, "versus" in the matter. The diagram has its useful place, and the formula has also its distinct use. The employment of the diagram for the derivation of a formula is often very convenient

The columns of the AMERICAN MACHINIST in years gone by will bear evidence enough to the fact that I am a very thorough believer in diagrams and have based many diagrams on formulas. Nevertheless I have also very frequently made use of diagrams to develop formulas and have found both of decided aid in my work. When a formula is complicated, its reduction to diagram will very materially save time if the formula is to be used frequently. On the other hand, it is often the case that a formula is very simple, so simple that the results can be arrived at by its use in less time than it will take to study out the arrangement of a diagram, more particularly in all those cases where the formula or diagram is only occasionally used.

There can be no question also that the diagram occupies very considerable space, and that hundreds of formulas can be written or printed in the space that would be occupied by a single diagram. No doubt this is one very good and sufficient reason for the almost complete absence of diagrams in engineers' pocket-books, and similar works. Imagine, for a moment, that the various formulas given in Kent's book were reduced to diagrams, and then imagine trying to find a publisher for the work, and imagine the publisher trying to find a purchaser at a price that would remunerate him. When investigations are made of related phenomena the observed results are best plotted; such plotting will give a diagram. It may be that the diagram will be of such nature that results which were not covered exactly by the experiments may be read from the diagram by interpolation. It will be found, as a rule, that the plotted results will not lie along regular lines, but will permit lines being laid through them that fairly represent averages. Of such lines, frequently quite a number differing slightly in their trend can be laid in which fairly represent an average of the plotted data within permissible limits of error. The difficulty then arises as to which of such lines had best be taken as fairly representative. Probably everyone will agree that that line which can be represented by the simplest and most rational formula will be the best. Its selection then at once leads us to the determination of a formula.

Such derivation of a formula from a diagram representing experimental data is decidedly justified in that the formula may possibly be a very simple one, and so be more simple in its use than would be the diagram; even where that is not the case, the formula may be inserted in a notebook, which can be readily carried about, as against the far more unwieldy diagram. For those who have occasion frequently to employ the matter, the diagram will be more useful, while for the occasional user the formula will undoubtedly be on the whole a labor saver.

In conclusion I should say that it is not a question of "Diagram versus Formula," but "Diagram and Formula," and the use of whichever arrangement of the information is the more convenient for the purpose in hand.

HENRY HESS.

In regard to the editorial, "Diagrams versus Formulas," I must say that the whole thing is very silly, and I can imagine the face of my old friend, Carl G. Barth, when he reads this editorial.

Now, gentlemen, when you don't understand all phases of the question, I would respectfully suggest that you leave it alone. Your remarks at the end, that "all this is rank heresy," show that you are expecting protests from engineers, and you certainly deserve them. A diagram is all right and very good for convenience to the engineer, but a formula is absolutely necessary to analyze the diagram and also to anticipate what may be expected in a similar series of experiments.

I am not writing entirely from an engineer's standpoint; I use diagrams and I use formulas in my engineering practice, and I often have to get on my overalls and help the men in the shop work out a difficult problem. It often takes less headwork to go into the shop and tool up a turret lathe than to try to do it on the drawing board; yet it can very often be handled on the drawing board much more economically than in the shop. Diagrams are not only a great convenience, but no engineer who is an engineer, in the correct sense of the word, is satisfied with a diagram alone. Certainly you can see a great deal from a diagram, and the average man, who is not a trained mathematician, can read the diagram much better than he can a formula. The mathematician can read them both; but for a great many things the formula is absolutely necessary. For instance, you can judge that a curve is probably hyperbolic in its nature from a diagram, but if you have a formula you know whether it is or not. If there is a limit to some part of the curve, you cannot determine it from the diagram, but from the formula you can tell it absolutely.

Please note that I know full well that you were talking about diagrams plotted from results of experiments, but what engineer would ever be satisfied with a

diagram if he had not some idea of the law governing the experiments from which the diagram was obtained; and how can this be determined without the formula?

Now as to the choice of a formula or diagram, we must first decide what use is to be made of it. A diagram founded upon experiments goes only so far as the experiments have been conducted. If we know the formula, we have the probable law that will reach beyond the limits of the diagram, and we can judge what to expect from new experiments, or we can construct hypothetical diagrams from these formulas that are very likely to run close to what we would get if we carried the experiments through a wider range.

Mr. Taylor has given us a most excellent paper, the result of years of labor and the expenditure of a great deal of money, and the formulas he has derived certainly have been a great assistance in the analysis of results. The fact that he has reduced a very complicated diagram to a mathematical formula is not to be condemned, but to be commended. I am sure it is fully appreciated by all engineers who, on original investigations, have found it necessary or desirable to derive formulas from the results of their experience.

The next time you feel badly, or have the blues and feel like relieving yourself in the columns of the AMERICAN MACHINIST, think twice and let the second thought be of your readers.

E. W. ROBERTS.

[Further discussion will be found on the editorial page.—ED.]

Connecting-rod with Escapement

Some time ago I had considerable experience with a mechanical motion which, when locked from any cause, was generally broken in some part; and unfortunately this tendency to lock could not be eliminated. One piece of the device was a connecting-rod.

Various methods were tried whereby these serious breakages could be avoided. At last we found the device of a laterally dissected connecting-rod fitted with an escapement, Fig. 1, to be so successful that we applied it to all subsequent motions.

The escapement acts the same whether the rod is under compression or tension along the line *A B*, and when it has released, as shown in Fig. 2, the strain on the various parts of the motion is at once released.

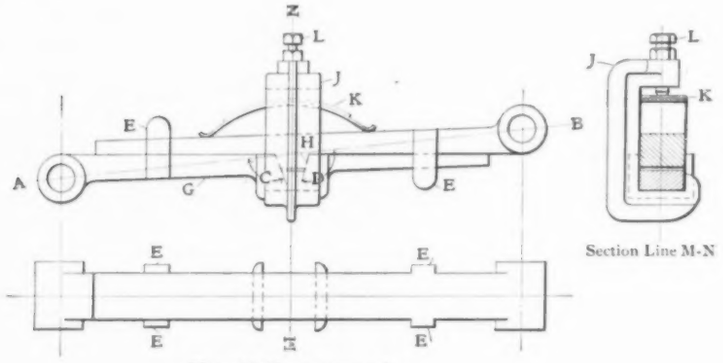


FIG. 1

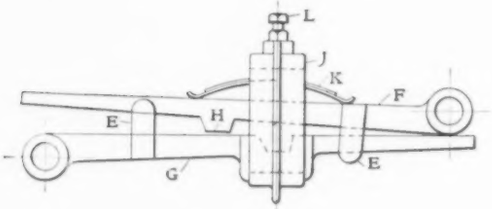


FIG. 2

CONNECTING ROD WITH ESCAPEMENT

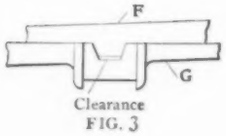


FIG. 3

As the rod was short in proportion to its travel, we found that it was necessary to bisect it throughout its whole length. Therefore, the bosses were thrown to opposite sides, as shown by Fig. 1. Referring to Figs. 1 and 2, the projecting part, or jaws, *E* are fixed, or cast on; one pair on part *F* and another pair on part *G*. They act as guides.

The tongue *H* should be carefully fitted to the recess in *G*, but must clear at the bottom, as shown in Fig. 3.

The angles *C* and *D* of the tongue *H* should generally be about 115 degrees and should be equal to each other measured from the line *A B* and not from the bearing surfaces of *F* and *G*.

The two parts *F* and *G* are held together by means of a buckle *J* and springs *K*. The strength of the springs will depend on the amount of pressure exerted by the connecting-rod. The pressure on the springs can be adjusted by the screw *L*, which is provided with a lock nut.

I always found it better to adjust the pressure of the springs while the machine was working. No play should be allowed between the surfaces of *F* and *G*, but on the other hand no greater pressure should be applied than is necessary to keep the parts together while performing their work.

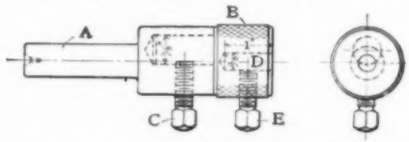
I have seen cases of weakened springs where the attendant had screwed them so far down as not to leave space for the tongue to escape from its recess, and so the whole device was rendered useless.

S. E. PACEMENT.

An Adjustable Boring Tool Holder

The accompanying illustration shows an adjustable tool holder, which has the merit of being efficient and at the same time inexpensive.

It consists of the machinery-steel shank *A* bored eccentrically to receive the nurled tool holder *B*, which can be clamped in any position by the set screw *C*. The boring tool or drill is carried in the hole *D*, and fastened by the set-screw *E*.



AN ADJUSTABLE BORING TOOL HOLDER

In practice the shank is gripped in the chuck usually provided with a milling machine. If desired of course the shank might be turned some standard taper to fit a standard arbor.

For comparatively light cuts on jig and fixture work this tool has been found very useful, and it is certainly an inexpensive one to make. S. W. MILLS.

A concrete building recently went through an accidental test that well shows the stability of such construction, when properly executed with good materials. The building has concrete frame and walls, and there are numerous large windows and doors. An explosion of acetylene occurred on April 2, killing or injuring everybody within, and blowing the windows, doors and woodwork into pieces. An examination of the structure by a correspondent revealed no crack or blemish anywhere on the concrete. The effect of such explosions on brick and timber buildings is proved by the records of the National Fire Protection Association to be very destructive, which makes the showing by this concrete structure all the more creditable.

Method for Ruling Parallel Lines of Any Spacing

Accuracy and Rapidity Attained by a Simple Addition to an Instrument Used by Every Draftsman

BY H. W. FISHER

The method about to be described was devised by the author at a time when he was making a special drawing of a machine in which there were a large number of pipe threads. The first step was to make out of a thin piece of wood a triangle of about the right screw pitch and then to divide the hypotenuse into equal divisions of such magnitude that as the triangle is moved along the tee-square the screw-thread lines will be drawn where the divisions of the triangle intersect the line representing the side of the screw. This device could be operated quickly and the conventional screw thread made with it was pretty and absolutely uniform. I then saw that the same plan could be used for cross-section drawing by using ordinary triangles with graduated edges.

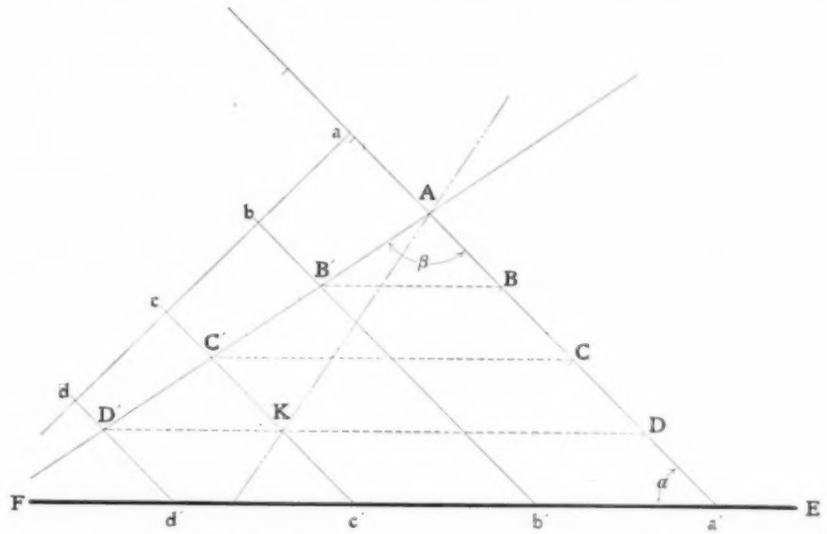


FIG. 1. ILLUSTRATING THE PRINCIPLE OF DRAWING EQUIDISTANT PARALLEL LINES WITH A GRADUATED TRIANGLE

Becoming interested in the subject I worked out graphical methods for drawing lines at any desired distance apart and I also developed mathematical formulas for the same. The question of applying for a patent was next considered but a careful inquiry developed the fact that graduated triangles have been used for cross-section work.

The writer fully realizes that expert mechanical draftsmen do not need a graduated triangle for doing uniform cross-section work, but there are no doubt many engineers like the author, who only occasionally make drawings and it is for the benefit of such that this paper has been written.

The Use of the Graduated Triangle

Fig. 1 illustrates the principle used in drawing equidistant parallel lines with a graduated triangle.

EF is the line of the tee-square edge and AD the side of the triangle with equal graduations, AB, BC, CD. α represents the angle between the edges of the triangle and tee-square. AD' is what I call the *reference* line and the angle β which it makes with AD is what determines the distances between the parallel lines $a\,a'$, $b\,b'$, $c\,c'$.

Having decided on a reference line AD' the line $A\,a'$ is drawn and then the triangle is moved along the tee-square to the left until B coincides with the reference line at B', when the line $B'b'$ is drawn. In like manner the triangle is again moved until the next mark C co-

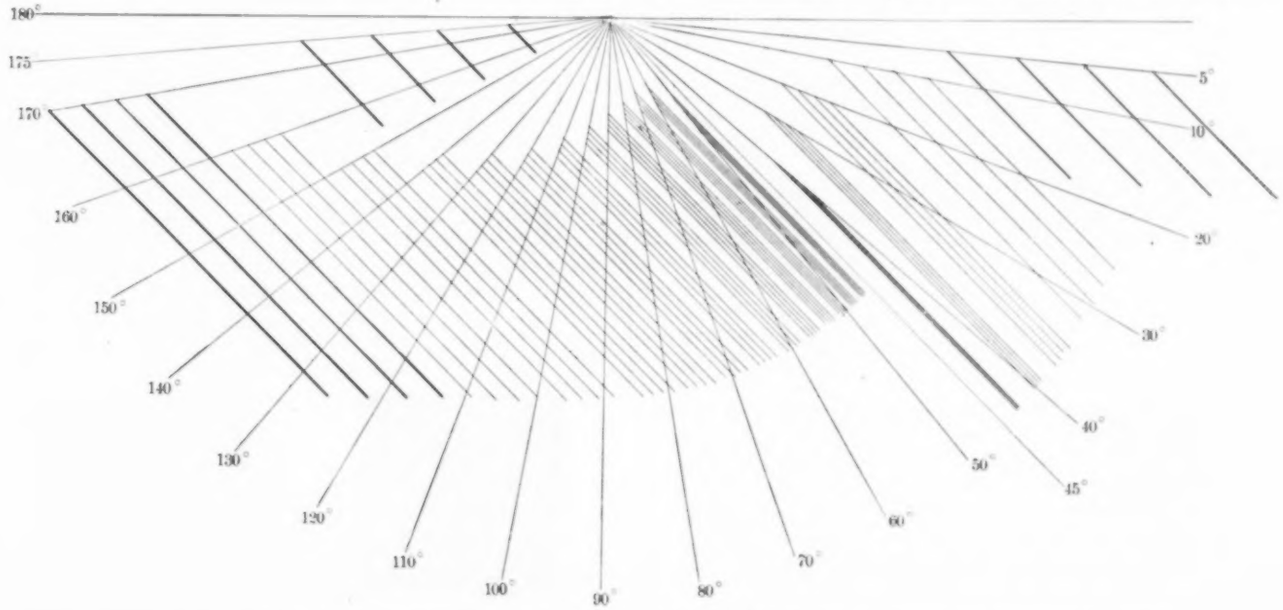


FIG. 2. SETS OF PARALLEL LINES RULED WITH THE SAME TRIANGLE, BUT TO DIFFERENT "REFERENCE LINES"

incides with the reference line at C' and the line $C'c'$ is drawn. This process can be carried on until the triangle is about off the paper when it is only necessary to lower the tee-square and adjust it with the triangle so that a graduation coincides with the reference line when the edge of the triangle is over one of the previously drawn parallel lines, then the process can be continued.

To Space the Lines at a Definite Distance

To draw lines at a definite distance apart proceed thus: Rule the line $a\,a'$ and draw a perpendicular line $a\,d$ which for the sake of accuracy should be at least three or four inches long. Lay off the point d so that $a\,d$ contains an exact multiple of the desired distance between lines, and then placing the triangle on the line $A\,D$, count from A a number of divisions equal to the multiple above referred to which we will suppose comes to the point D; then slide the triangle along the tee-square until the edge of the former passes through the point d. D is not at D' and a line joining A and D is the desired "reference line."

Using exact figures, suppose it is desired to draw 31 lines in 3 inches, first draw the perpendicular $a\,d = 3$ inches, then place the edge of the triangle over $A\,B$ with a graduation at A, count off 31 divisions; and, keeping track of the point, move the triangle as above described, and when its edge is over d, draw the reference line through A and the 31 division mark.

Suppose we want to divide the line $A\,C'$ into n parts, we first rule the parallel lines $A\,D$, $C'c'$ through the ends of the line, and making a graduation of the triangle coincide with A, we mark off n divisions which, we will suppose, come to D; then, sliding the triangle along the tee-square, D crosses the line $C'c'$ at K and the reference line is $A\,K$.

Having thus found these various reference lines, the requisite number of lines or divisions can be made by advancing the triangle one division at a time and ruling or marking with a pencil or pen.

Fig. 2 represents various sets of parallel lines with corresponding "reference lines" ruled at angles from 5 degrees to 175 degrees, as shown. Each set of parallel lines ends at its "reference line." A 45-degree triangle was used and it will be noted that starting at 45 degrees the spacing between lines becomes larger and larger as the "reference lines" approach the horizontal line.

Accurate Results

So extremely accurately can ruling be done by this method that it is easy to make certain kinds of sectioning, which require extreme perfection to present an appearance of uniformity. Fig. 3 shows a section representing squares. Here each set of cross-section lines were ruled without reference to each other, but it will be noted that the lines meet at the horizontal lines at the top of the drawing. A vertical line was used as the "reference line."

A much more difficult cross section is represented by Figs. 4 and 6. Here we have regular hexagons between which are small triangles. This represents a cross section through a winding of many turns of insulated wire. A 45-degree triangle with 1/10-inch graduations was used and the tee-square was adjusted so that the necessary 60-degree lines could be drawn. The "reference line" was vertical, four divisions and two divisions respectively to each space being used in Figs. 4 and 6.

Fig. 5 shows a section representing hard rubber. Here also a vertical "reference line" was employed, one-division and two-division spacing being used respectively for the light and dark portions.

Representing Screw Threads—Use of a Long, Narrow Triangle

Returning once more to the subject of drawing the conventional screw thread or its equivalent, there are three methods that can be used:

First—By a long, taper triangle $A\,D\,E$, shown in Fig. 7. $A\,E$ is the line of the tee-square and the triangle is moved along it a number of divisions corresponding to the size of the screw. The side of the screw is the "reference line."

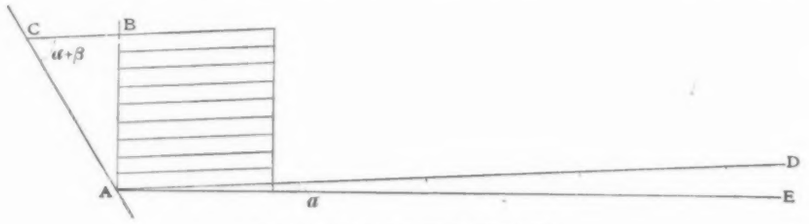


FIG. 7. RULING SCREW THREADS

This method is not practical for long screws because the triangle and tee-square have to be adjusted so often.

Use of the Graduated Triangle

The second plan is to use a graduated triangle and determine the "reference line" as follows: Place the graduated edge of the triangle on the line $A\,D$ of the screw thread shown in Fig. 7, and adjust the tee-square so that the triangle can be used to draw lines parallel to $A\,D$.

Count off to the right from A a number of scale divisions equal to the desired

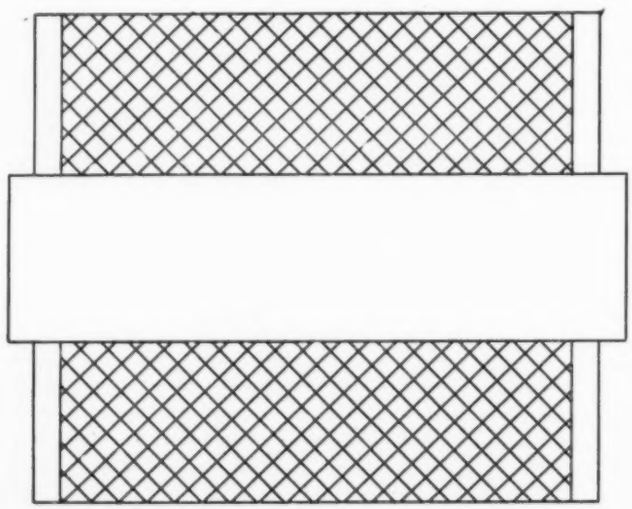


FIG. 3.
SQUARES RULED BY THE GRADUATED TRIANGLE

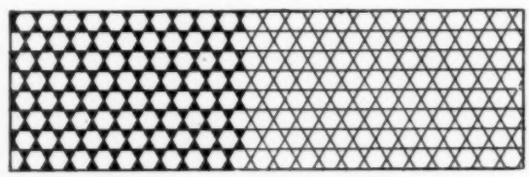


FIG. 4.
HEXAGONS AND TRIANGLES
RULED BY GRADUATED TRIANGLE

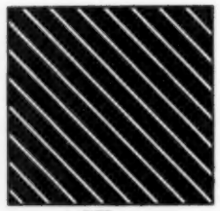


FIG. 5.
CROSS-HATCHING
FOR HARD RUBBER

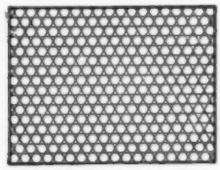


FIG. 6.
SAME AS FIG. 4.
BUT ON SMALLER SCALE

number of threads between A and B, then slide the triangle along the tee-square until the point counted off cuts the line CB at A. AC is the desired "reference line."

Use of a Bevel Device

The third plan is to use a device which can be set to rule lines at any desired angle, either side of the screw being used as "reference line." Referring to Fig. 7, AC is now the line of the tee-square and ACB the angle at which the ruling device is set, CB representing the graduated edge of the ruler.

In order to make such a device at all practical a table should be constructed giving the size and pitch of screw threads, angle of pitch line and angles at which to set ruling device for different scale drawings.

I am fully aware of the fact that conventional screw threads are not generally drawn to size, but having worked out several years ago a method of figuring such a table, I thought I would mention it. I believe that a complete table and ruler such as here descibed could be used to advantage in many drafting rooms.

Lack of Uniformity in Phosphor-bronze Springs

If a spring of a non-ferrous alloy is desired which will give the best results, phosphor-bronze is usually specified. If the mixture is rightly made, the spring cannot be surpassed by anything except steel, but if not, it is much inferior to a yellow brass one.

Experience has taught that if the phosphorus in rolled metal exceeds 0.05 per cent., the bronze is injured.

The greatest variation in rolled or drawn phosphor-bronze is caused by the tin content. A bronze which contains only 3 per cent. of tin is inferior to one which contains 8 per cent., although both may be phosphor-bronze. On account of the difficulty in rolling or drawing phosphor-bronze containing a high tin content, manufacturers will substitute a lower percentage if it is possible to do it.

A good spring should contain only copper, tin and a very small quantity of phosphorus.

Those who have had trouble with phosphor-bronze springs should ascertain whether their troubles are not caused by the absence of the necessary amount of tin, or the presence of zinc. The temper is produced by cold-rolling.—*Brass World.*

An interesting innovation in coal-mining practice is reported, says *Nature*, where at a colliery at Shamokin, Penn., concrete has been substituted for mine timbering. A plant for the manufacture of these cement props is in course of erection at Trevorton.

Machine Painting

By T. A. Sperry

Very few managers seem to realize what constitutes good painting, or to discriminate between the different grades of finish required for different classes of machinery. A high-class machine tool requires a better finish than a locomotive or pump—a pump requires a better finish than a laundry mangle, and the cost of painting is nearly proportional to the finish required. I do not wish to urge cheap painting—in fact, I think we err on the side of "cheapness" too frequently as it is—but I've come to learn that while maintaining present standards of finish, our machine painting is costing 50 per cent. more than it should; and this saving can, in most cases, be effected by the use of the so called benzine process. The time element of this process, as compared with the customary knife and sandpaper method is very strikingly illustrated by the accompanying table, taken from actual practice in an engine-building shop in the Middle West.

Size of Engine.	Type and Style.	Old Method Working Time. (Ave. Practice.)	Old Method Premium Limit.	Benzine Process Working Time.	% Saving of Benzine over Old Method Working Time.	Remarks {On Benzine Process Conditions.
		Hrs.-Min.	Hrs.-Min.	Hrs.-Min.		
7" x 10"	Cent. crank; overhanging cyl.; slide val.; throttle.	11 20	8 0	4 25	61	Med. Castings, rusty.
11" x 16"	H. D.; overhanging cyl.; slide val.; throttle.	15 30	10 30	5 0	68	Med. Castings, good finish.
13" x 18"	H. D.; overhanging cyl.; slide val.; auto.	19 10	12 0	7 55	59	Rgh. Castings, very dirty, medium finish.
12" x 14"	Cent. crank; overhanging cyl.; slide val.; throttle.	16 20	13 50	7 45	53	Med. Castings, rusty, fine finish.
14" x 20"	H. D.; overhanging cyl.; slide val.; auto.	16 55	14 10	12 0	30	Med. Castings, wavy and poorly cleaned. Workman slow and green.
17" x 22"	H. D.; overhanging cyl.; slide val.; throttle.	22 0	17 05	10 45	51	Very rough castings, good finish.
48" x 12"	Band wheel.	4 0	.. ..	1 0	75	Average Castings, good finish.
66" x 15"	Band wheel.	5 0	.. ..	1 15	75	Filler got too dry and made rubbing slow, fair finish.

COMPARISON OF WORKING TIME FOR PAINTING ENGINES BY OLD METHOD AND BY BENZINE PROCESS.

In further explanation of this table I may say that the time shown for the benzine process is made by ordinary "green" laborers at 16 to 18 cents per hour, while the old-method times are those made by professional machine painters at much higher wages. With practice the laborers can materially reduce the time given in the table for the new process, and at the same time in many cases, improve the quality of the finish. The time given in the table includes in all cases priming, filling, rubbing, coloring and varnishing complete, and doping all polished and bright portions ready for shipment.

As the benzine process may be new to many, I give it in brief as follows: The casting is primed with ordinary primer as soon as it comes from the foundry to prevent its rusting. When ready to paint, it is covered with the usual iron filler reduced with turpentine to as stiff a paste as can be applied with a round, stiff brush. This is followed by a second coat of the same material, and all rough portions given possibly a third or fourth coat, each coat applied with the brush before the former is dry—generally the coats follow each other immediately. The casting is then left for from one to three hours until the filler begins to harden, when it is rubbed down by a soft brush and a piece of heavy felt soaked in benzine (turpentine can be used, but benzine is better) until smooth. It is then colored in the usual manner, using a single coat of color, a coat of shellac, and one of color, a coat of color and one of varnish, or one of shellac, one of color and one of varnish, according to the depth of color required. The painters' knife and sand paper are not used at all, except in exceptionally bad spots.

In fairness to the method it is but right to say that if castings are very rough or irregular the results are not as good as those attained by the use of the knife and sandpaper; but with reasonably good castings the results are in general superior. The observations on which the table is based extend over a period of three weeks for the benzine process and about two months with the old method. The premium limits set on the old method had never been reached by the workmen.

An international exhibition will be held in Japan in the year 1912. The buildings to be erected by the government include two scientific buildings, two industrial buildings, two machinery and electric buildings, transportation building, marine product building, and 10 other large buildings. The site of the exhibition has not been selected, but the finance department and Tokyo municipal authorities are reported to have agreed to hold the exhibition within or in the vicinity of Tokyo, and the Tokyo Municipal Council recently voted an unconditional contribution of $1,500,000.—*Western Electrician.*

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Diagrams versus Formulas

On another page will be found answers to our recent editorial under the same title as this one, by Carl G. Barth, Henry Hess and E. W. Roberts.

We may say at once that in accusing us of not grasping the diagrams and formulas of Mr. Taylor's paper as preliminary steps to the construction of special slide rules, Mr. Barth is just, and he successfully defends his own use of formulas because they have a purpose and are, in fact, necessary to the laying out of his slide rules. Although, however, Mr. Barth is successful in defending his own use of formulas, we are unable to see that he is successful in defending their use in the cases which we had in mind when writing the previous editorial. He has successfully pointed out not that our contention is untrue, but that the illustration which we cited was unfortunate. The case which we had in mind, and for which we unwisely selected Mr. Barth's formulas as an illustration, is one in which the diagram obtained directly from the observations gives all the information at hand and in a form for convenient use. We are unable to see that Mr. Barth's argument applies to this case or answers our contention that in such a case the formula is superfluous.

Mr. Hess defends the formula as a means of determining which one of several possible lines is most probably the true one—the formula being used in a sort of refining process to locate the final lines chosen with greater accuracy than is possible by merely drawing a smooth curve between more or less discordant plotted points. The argument is sound *if* such a refining process is advisable, which we doubt. If the discordance among the plotted points which results from the direct plotting of the observations is small, a resulting smooth curve drawn by the eye may be located with all necessary accuracy; and, on the other hand, if the discrepancies are large, we very much doubt the worth of any refining process applied to them. When it is possible to draw several lines among the plotted observations, any one of which, so far as the eye can determine, may be fairly used, the conclusion to be drawn is that the experiments do not justify any dogmatism as to the exact location of the line, either because they were not strictly accurate or because the subject experimented upon does not permit of accurate investigation. To apply a mathematical refining process to the determination of the most probably correct curve in such a case is, it seems to us, somewhat analogous to the use of an unnecessary number of decimal places, as it is an attempt to secure accuracy beyond that justified by the data at hand.

We are not prepared to admit that a pocket-book based on diagrams would be unsalable. The matter is not one to be decided offhand, as the comparative cost would have to be considered, of course; but we have a very decided feeling that such a pocket-book, if it could be sold at a reasonable price, would prove to be a very popular publication. True, the use of diagrams in place of formulas would increase the amount of paper necessary and the bulk of the book; but, on the other hand, the diagrams would replace many tables as well as many formulas. Such a book would, we have no doubt, be larger than existing pocket-books, and probably could not properly be called a pocket-book at all; but, for that matter, many of the existing pocket-books are scarcely such in any true sense. As time has gone on, the books have increased in volume, but the old name has been retained until it has almost lost its significance. We believe that the advantages of diagrams would justify a reasonable increase in the size of the resulting book.

We are unable to see the significance of Mr. Roberts' criticism. Except in such cases as those of Mr. Barth, which certainly are not average ones, we are unable to recognize the usefulness of knowing that a given curve is hyperbolic in its nature, nor are we able to see why a diagram cannot be carried beyond the limits of the experiments as well as a formula. As a matter of fact, it is the commonest thing in the world to so extend a diagram. We are, in fact, unable to see how a formula derived from a diagram can tell any more than the diagram can tell. Just as water does not rise above its source, and just as the strength of a chain is determined by that of its weakest link, so a formula based on a diagram cannot give more trustworthy results than the diagram itself.

To sum up, our contention is that when a formula is a means to a useful result, regardless of what that result may be, the formula is justifiable; but that when the formula, instead of being a means, becomes an end and gives no information beyond that given in a diagram, it represents wasted effort.

Selecting Men for Our Consular Service

The examination of applicants for appointment to the consular service, which was recently held in Washington, is said to have produced results that are highly gratifying to the State Department. This examination was the first to be held under an executive order founded on the act passed by the last Congress for the reorganization of the consular service, and twenty-one designations were made from eleven States which at this time have less than their proportionate representation in the service. From more than a hundred applicants desiring to take the

examination twenty were selected, after careful inquiry, as being best qualified for the work expected of consuls, and of this number ten successfully passed the examination. As there are several more vacancies to be filled, another examination is shortly to be held, probably during the month of July.

The consular examination is oral and written, the object of the oral test being to determine the business ability and natural fitness of the candidate, his alertness and general information upon contemporary matters. The examinations are divided into eight subjects, which, with their relative weights, aggregating 20, are: Modern language—French, German or Spanish—4; natural, industrial and commercial resources and commerce of the United States, 4; political economy, 2; international, maritime and commercial law, 3; American history, government and institutions, 2; political and commercial geography, 2; arithmetic, 1; modern history (since 1850) of Europe, South America and the Far East, 2.

A summary of the examination already held shows that the questions asked were all of a practical nature and well adapted to bring out the important facts with which men qualifying as consuls should be acquainted. Referring to the character of the examination, the New York *Evening Post* says:

"Critics of the new order of things in the new consular service have been disposed to make light of the announcement that this examination would be practically a civil-sevice examination. With the exception of the oral examination the test was practically the same as that required of candidates for the civil service. The whole machinery of the civil-service commission was used to conduct this examinaton. Mr. Kiggins, the chief examiner of the civil service, was a member of the board of examiners; the other two being Mr. Wilson, third assistant secretary of state, and Mr. Carr, chief of the consular bureau. The same forms used in civil-service examinations were utilized in the consular examination, and the indorsements of the various candidates were not before the board of examiners at any time while the test was in progress.

"Each candidate selected a number, which was written at the top of his paper, and when the written part of the examination had been completed and the candidates came before the board separately for the oral quiz, they were called for by numbers, the examiners not even knowing the States from which the candidates hailed.

"Civil-service examinations are competitive. The consular examination was not competitive. Personality plays an important part in the work of any consular officer, and it was for this reason that the oral examination was arranged. The board in its oral examination of the candidates addressed itself to discovering the character, disposition, address, manners, health, personal appearance, readiness, judgment, discretion, resourcefulness, currency of information, experience and business capacity of the candidates. A man might easily pass a perfect written examination and yet, because of his personality, be unsuited for consular work. The oral test serves as an effective barrier against this class."

Of the ten men who are soon to be appointed to their respective positions six are under 35 years of age and three under 30. The eldest is 43 and the youngest 26. In the majority of cases the salary attached to the positions they are to fill is $2000 per annum, the executive order referred to above limiting appointments from outside the service to positions paying $2000 to $2500 yearly. Each of these men has had considerable business experience, a few have already seen service in the field, and several have traveled extensively in foreign countries in the interests of manufacturing and mercantile establishments.

A Great French Machine Tool Works

According to Consul General F. H. Mason, of Paris, there has recently been organized in Paris under the presidency of M. de Dion a corporation with a capital of 6,000,000 francs ($1,158,000), to undertake the manufacture of machine tools, especially of the type which are essential in the manufacture of automobiles.

Mr. Mason continues his report thus:

The original supremacy of French manufacturers, the perfection of their work in the construction of high-grade motor vehicles, is generally conceded. But within the past two or three years certain of the best makers in Great Britain, Belgium, Germany, and the United States have begun to compete seriously even in the best class of cars for touring and ordinary purposes. It becomes, therefore, evident that in order to maintain the competition and continue the present export of automobiles—which amounts in value, roughly, to 100,000,000 francs ($19,300,000) per annum—French manufacturers must economize at every point and keep their industry as closely as possible within their own control.

Thus far the French automobile factories have been equipped to an important extent with machine tools imported from several countries, notably the United States and Germany. The official statistics do not classify separately machine tools used for automobile construction, and for other purposes, but it is a matter of common knowledge that most of the automobile lathes, gear cutters, boring, milling, and finishing machines used by the French motor-car manufacturers are of American or German origin.

Importation of Machine Tools

The French statistics show importations in 1905 of 12,174 metric tons of machine tools, valued at 18,261,653 francs ($3,524,499), of which 6125 tons, or about half, came from Germany, 2424 tons from the United States, 2159 tons from Great Britain, and the remainder from Belgium and Switzerland. These, however, are custom-house figures—correct in respect to weight, but far below the fact in respect to values. A financial authority, Le Credit Mutuel, estimates the actual value, including duties, of imported machine tools put into the French automobile manufacture in 1906 at 25,000,000 francs, or $4,825,000.

To obviate this heavy drain upon the automobile industry, cheapen the cost of equipment, and keep the whole economy of that important branch of manufacture more completely within French control are the purposes of the new enterprise. The incorporators and stockholders include some of the best-known names in the French automobile manufacture, and its capital had been fully subscribed before the scheme became publicly known. It will establish works for the construction of such machine tools as are not protected by patents, and presumably seek to acquire rights to manufacture under such patents, domestic and foreign, as cover devices which are deemed essential. This will create the most dangerous competition that the machine-tool makers of America have ever been called to meet in France. The import duty on such machinery ranges from 17 to 70 francs per 100 kilograms ($3.28 to $13.51 per 220 pounds) according to weight of machine, but the French tariff is a flexible enactment and can be modified to meet any existing or future relation between home supply and actual demand.

Though the workings of any trust are hard to fathom and too much credence should, in consequence, not be accorded surface indications, it is reported that the Majestic distillery at Terre Haute, Ind., which was equipped by the alcohol trust to make denatured alcohol on a large scale, is still idle and there is little prospect of its starting up in the near future. The Industrial Company, formed by the trust to place the denatured alcohol on the market, is said to have found that the product cannot compete with gasolene as yet. Another trust plant, the Atlas distillery at Peoria, Ill., which was running in full blast, using 7000 bushels of corn daily in the making of the denatured product, has been cut down to 2500 bushels a day. It is thought that the Majestic plant will be allowed to remain idle until fall.—*The Automobile.*

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

Drilling and Milling Machine

The half-tones illustrate a new machine designed for doing a variety of drill-press and vertical-miller work. As will be noticed, the table of this machine is mounted on a cylindrical support which is carried by the column and graduated to allow the table and saddle to be tilted to any desired angle. Longitudinal and cross movements of the table are obtained by means of screws fitted with graduated dials, which permit the operator to set the table accurately when laying out work and performing various operations. The spindle runs in a bronze taper sleeve fitted in a cast-iron sleeve provided with means of compensating for wear. The end thrust is taken by a ball bearing as indicated. The hole for end mills and chucks is No. 7 Brown & Sharpe taper. The drill guide, which is shown in place in Fig. 1, is brought into service when laying off and drilling holes in dies, jigs, and other work where the holes are required to be at certain definite distances apart. It is also used to prevent the drill from running to one side when entering surfaces that are not at right angles to the drill. The circular table shown in Fig. 2 is graduated in degrees through the entire circle. The equipment includes a drill plate which is bolted to the surface of the table when drilling operations are to be performed, and a swiveling vise with graduated base. The table measures 6x18 inches, has a transverse movement of 10 inches and an in-and-out movement of 6 inches. The head has a vertical adjustment of 8½ inches and the spindle a vertical movement of 3 inches. The diameter of the largest piece that can be drilled is 15½ inches. The builder is the W. B. Knight Machinery Company, St. Louis, Mo.

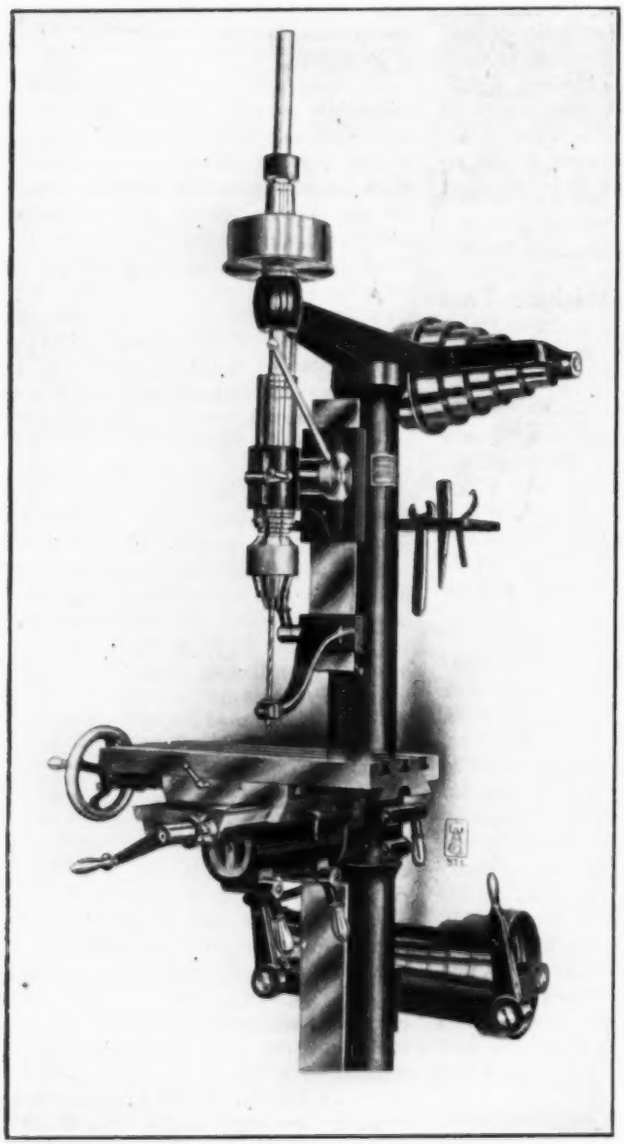


FIG. 1.

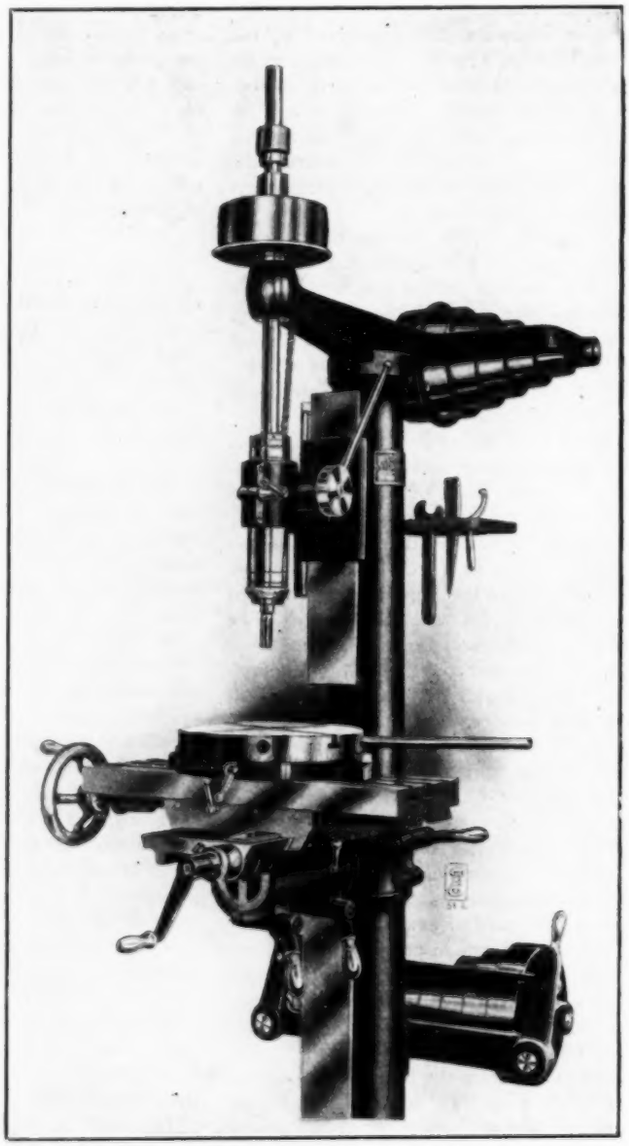
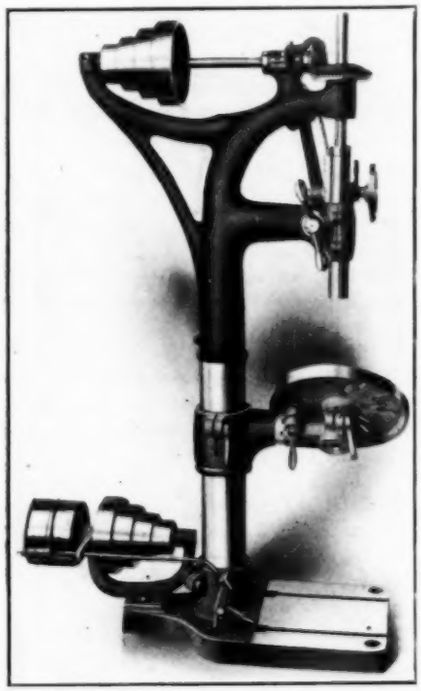


FIG. 2.

DRILLING AND MILLING MACHINE

Upright Drill with Tilting Table

The half-tone shows a drill press equipped with a table which may be tilted and clamped in any position about a horizontal axis, and as the table has the usual feature of being capable of being rotated about an axis located in a vertical plane, it will thus be easy to drill work at any angle without removing it from the table. The makers of this, The General Manufacturing Company, of Elkhart, Ind., are prepared to fit this table to any driller by boring out an arm to fit



UPRIGHT DRILL WITH TILTING TABLE

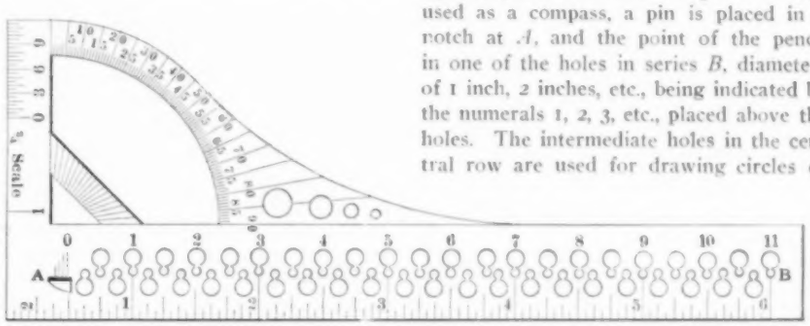
the vertical column. It can also be furnished with their regular 21-inch upright drill.

A 32-inch Lathe

The 32-inch engine lathe shown in the accompanying half-tone is one of a line of heavy tools, the 36-inch size of which was illustrated in these columns at page 521, Vol. 29. The spindle of this machine has a front bearing 5¾ inches diameter and 9½ inches long; a hole 2 11/16 inches diameter is bored through from end to end. Both front and rear boxes are of bronze, taper and split and provided with square-thread nuts at either end for adjusting for wear. The thrust is taken on bronze and tool-steel rings, the latter being hardened and ground. The spindle is back-geared in the ratio of 15 to 1. With a single-speed countershaft 10 spindle speeds ranging from 3 to 350 revolutions per minute are obtained. The change-gear box is of the sliding-gear type, and a positive clutch between the driving shaft and the lead screw makes it easy to cut threads of special pitch. The mechanism of the gear box is similar to that shown in detail in connection with the 36-inch lathe referred to. In addition to the usual range of threads, spirals of one turn in 1 inch to one turn in 12 inches may be cut. The apron is of the double-wall box form and bevel-gear driven. When either the cross or longitudinal feed is in, the lead-screw nut is automatically locked in open position and *vice versa*, so that the same feed and either of the other feeds cannot be engaged at the same time. A friction binder controls either feed, and the hand-wheel pinion may be disengaged while cutting threads. A taper attachment is fastened to the rear of the carriage. It will turn tapers up to 4 inches per foot and 24 inches long, and is graduated both in inches per foot and in degrees. The carriage bridge is 12½ inches in width and of trussed form. Slots, front and back, are provided for clamping work to the carriage, and there is also a carriage binder for facing work. The compound rest has power feed in all directions (cross and angular) and is graduated in degrees. The cross-feed screws are graduated. The tailstock has a pawl engaging a rack cast solid in the bed, thus preventing slipping when under heavy duty. The lathe is built by the New Haven Manufacturing Company, New Haven, Conn.

Ready Drafting Instrument

The line engraving herewith illustrates an instrument designed for use as a scale, square, protractor and compass. When used as a compass, a pin is placed in a notch at *A*, and the point of the pencil in one of the holes in series *B*, diameters of 1 inch, 2 inches, etc., being indicated by the numerals 1, 2, 3, etc., placed above the holes. The intermediate holes in the central row are used for drawing circles of

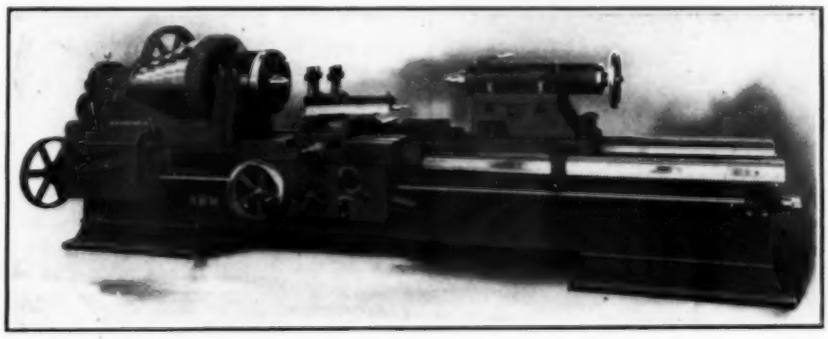


READY DRAFTING INSTRUMENT

diameters of ¼, ½, ¾, 1¼ inches, and so on, the series being spaced at ⅛ inch intervals. In making a circle whose diameter is in sixteenths, the inches and quarters are located in the row of pencil holes, then the pivoting pin is moved to the left of the zero notch, each notch increasing the diameter by 1/16 inch. The large holes tangential to the central row enable the paper to be seen immediately in advance of the pencil point, this being a convenient feature when an arc is being drawn, connecting the two sides of an angle. The instrument is made of aluminum and measures 6¼x2⅜ inches. It is made by the Ready Manufacturing Company, Rochester, N. Y.

A Combined Sensitive and Back-geared Drill Press

In the belief that there was a gap between the regular sensitive drill and even the lighter drills with back gears, the Francis Reed Company, of Worcester, Mass., has brought out the type of drill illustrated herewith. In the aim to retain good features from each type this drill is full back geared with a ratio of seven to one, so as to drill up 1 7/16 inches when desired; but throwing out the gears

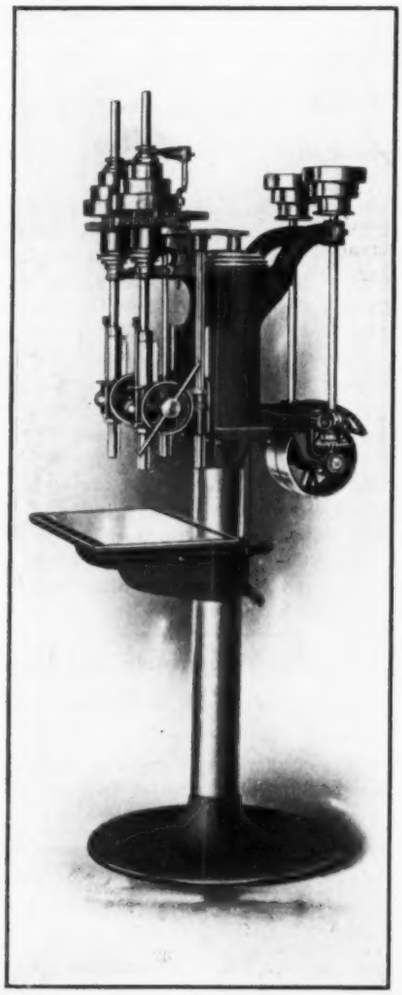


32-INCH LATHE

leaves as powerful a sensitive drill as will be required.

They have a newly designed automatic feed with three speeds, from 0.009 to 0.014 inch for each revolution of the spindle, and with a countershaft speed of 450 revolutions per minute. This will give a feed of 10 inches a minute.

The countershaft is mounted on the machine and drives the upper cones through bevel gears. By making one of these of rawhide, quiet running is assured. Each spindle is also independent



COMBINED SENSITIVE AND BACK-GEARED DRILL PRESS

both in drive and feed, the latter belting back to its spindle so that the feed stops whenever the spindle does. The driving belt is straight and open, 1½ inches wide.

The spindles have a bearing 1 inch in diameter through the quill and a feed movement of 6 inches, together with a 4-inch adjustment of the sliding head on the column.

The back gears are stationary when not engaged, and any set can be thrown in or out at will, so that one spindle can be running back geared and drilling up to the full capacity of the machine, while the next may be used on the most sensitive work.

The table is adjustable in hight, can be swung around the column at will, is counterweighted so as to be easily handled, and will drill to the center of a 16-inch circle.

Fly-wheel Hub Troubles

By Geo. H. Johnson

After reading the discussion on the merits of the Haight fly-wheel joint I could not help (in view of some experiences) but conclude that the present design of wheel centers is just as susceptible of criticism.

Recently, one of our 18-foot balance wheels on the crank-shaft of a heavily overloaded engine began to show signs of distress and started to move on the shaft. By putting in the 3-inch hub bolts hot we could hold it for a time, but in about a week it invariably became loose. The hub was of the usual 4-bolt design with about a 1-inch space between the two halves of the hub, the keys being in one-half of the hub only. To confirm my suspicions I had a small space trued up between the two faces of the hub, and very carefully fitted in a piece of ⅜-inch copper rod 1 inch long; this was then fastened in place with sealing wax, after having been measured with a micrometer. When the wheel again became loose the piece of copper was taken out and found to be only 0.92 inch long instead of 1 inch. This showed that one-half of the wheel had turned as rotated nearly one-tenth of an inch. This wheel was finally cured by fitting liners between the hub faces.

A wheel of similar design in No. 4 mill, 16 feet in diameter with a 30-inch belt on it, failed by breaking three spokes at the hub, all on the half of the hub which carried the key. The present wheel in this engine is planed across both hub and rim and by good careful machine work the faces of the hubs meet when the shaft is gripped hard.

I am rapidly coming to believe that cast iron for fly-wheels of any size is in much the same class as the lap joint for boilers. Why not use steel plate, as I believe some of the German builders do?

Again, an 8-foot exceptionally heavy balance wheel on a 12-inch shaft running at 280 revolutions per minute and subjected to continuous heavy shocks developed cracks in nearly every arm. This wheel was about one year old and looked good. It was replaced by another of the same design, and inside of three months this was in much the same condition as its predecessor. These wheels were of the old, familiar, heavy-rim, heavy-spoke and heavy, solid-hub type, a design that is almost criminal. The cure in this case was to cut the hub into six pieces, finish it both inside and out and shrink on hoops of 4-inch square steel forged from the solid. There is no guess-work about that wheel now; we know about what load is on those spokes.

The spokes of a belt wheel that "let go" in No. 4 spread open and sideways about ¼ inch, showing the great initial strain that the wheel was under from shrinkage. This condition, I believe, exists in many of the cast-iron wheels at present in use. I may be a bit "raw" on cast iron as a material for fly-wheels of large diameter, but in view of the above I think it is deserved. We have one wheel running which weighs about 45 tons and is a credit to its designer. He cut the wheel in five pieces and used each piece to hold the joint of the piece next it. This I know is not new, but it looks about right "from the street."

Bread from Brick-bats

If somebody should announce that he had discovered a substance which, sprinkled upon a peck of builders' sand, would change it into a dozen cut-glass tumblers, we wonder if the daily papers would proclaim the discovery in all seriousness and print two-column pictures of the discoverer, as they are doing of John Elmore, the alleged discoverer of a compound which, sprinkled upon ashes, "causes them to burn with a fiercer heat than the best bituminous."

John is "so illiterate," one of the articles states, "that he is compelled to seek assistance in writing to drug houses for his ingredients"; but in our opinion John knows a good deal more than the newspaper man who prints John's portrait on the front page of a metropolitan daily, with a two-line title, turn-over story full of such rot as: "He has without doubt or question created a chemical compound which is bound to have a tremendous effect on coal production so long as coal is used as fuel." "He has not even an elementary knowledge of organic chemistry, and yet he has discovered a combination which the most eminent chemists in the world have been seeking for years." We say "knows more," because it could not be that the publishers of such papers, knowing better, would let such misleading twaddle appear in their reading columns even for money.

Of course, the man has not invented nor found anything of the kind. Ashes, except for the modicum of unburned coal unwittingly removed with them, are absolutely incombustible. If John has found anything outside of carbon or hydrogen or some of their compounds which will burn, he might as well use sand or anything else for a wick as ashes, and save buying the initial coal. The announcement that such a substance, commercially available, had been discovered, would be equivalent to the announcement of the discovery of another continent on this much explored sphere.

The only harm that comes from such

articles as these, aside from making their promoters and publishers ridiculous, is the divorcing of still more ignorant and trusting dupes from their good money through the apparent indorsement which the alleged discovery receives from such a presentation.—*Power.*

Forging-press Dies for Rail Tongs and Wrenches

By Pressman

There are two classes of presses in forging-press work, one that has a friction clutch so the press can be started or stopped at the will of the operator, while the other runs continuously. The friction-clutch machine covers a much wider range, from the fact that it is under perfect control at all times, and can be stopped instantly if the work requires it.

Making the rail tongs, shown at *A*, Fig. 1, or the rail fork at *B*, requires a press with a clutch to punch the rivet hole and cut the slot, as the machine must be stopped to get them in and out of the dies, and also in bending the jaws of the tongs and riveting them together.

The Dies Used

Handles on tongs and forks are first drawn under a steam or beam hammer, and come to the press, as shown at *C* and *D*. The special dies for rail tongs are shown at *E* to *K*. *E* and *F* are combination dies to work the jaw down to 1x1½ inches. An ordinary flat die is used for the top, but overlapping the bottom die at least 1½ inches on the front and back. This cuts the shoulders for the eye. When to size, they are sheared off to the right length. They are then punched, bent and thrown aside, as the riveting is done after they are all finished.

The dies for rail forks are shown from *L* to *R*, being a pair of flat dies, swaging dies, and the punch and die for the slot.

The rough end is cut and chamfered under the shears, which should be kept sharp to do the work right.

The punch *P* is generally made flat, but if made fish-tail shape, as shown, it is much easier on the machine, on the punch and the die, and does the work better if anything. The steel gets chilled by the time it is ready to slot, and the fish-tail pattern cuts much the easier of the two.

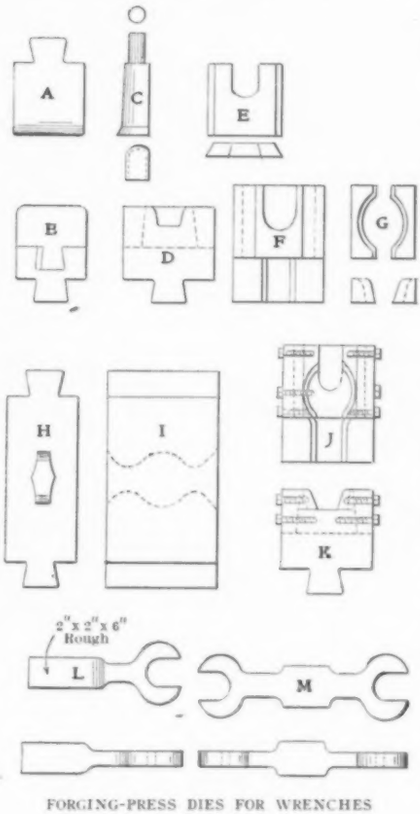
It takes quite a shop to get out 15,000 track wrenches of various kinds on short notice, and this is where our forging presses came in very handy. Two presses made from 600 to 800 per day, and it did not take long to fill the order.

Forging Wrenches in the Press

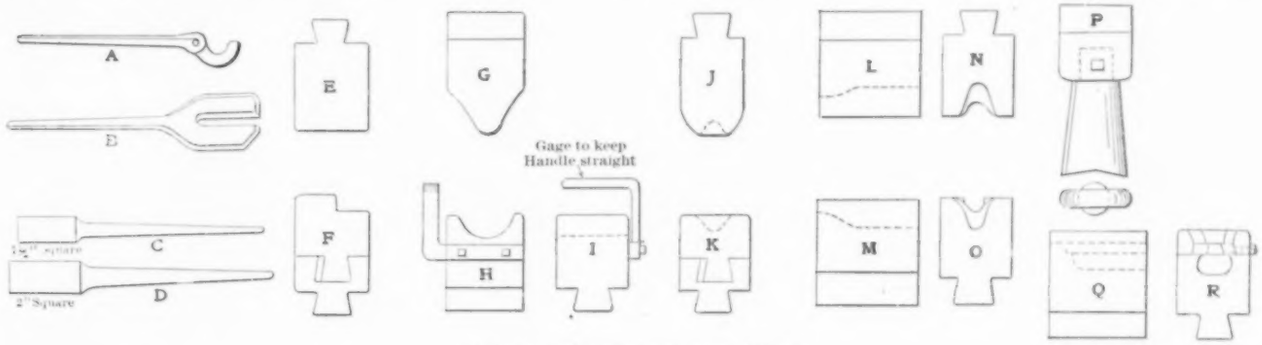
Wrenches made on a press present a neat appearance if the dies are kept in good shape, and the operator is careful about his work. The handles are swaged out under a beam or steam hammer, as the press is not quick enough for this class of work. The dies are simple, but, like other press dies, they must be made right and set right in the machine.

One set of dies will make four sizes of jaws by changing the punch and punch-die once. This is accomplished with blocks which spread the jaws or squeeze them together in the ring dies *H* and *I*, after punching. The punch-die block *D* is the most important, as the punch die and gage ring must fit accurately, else the slot in the jaw will not come straight, and this causes a lot of trouble.

Block *E* is dovetailed and just slips in the block the same as *G*, which is set on top of *E*. Both are fastened to the block by ⅝ cap screws. *J* shows the whole arrangement. Dies *G* should have at least ⅛ inch clearance, as the punch spreads the hot stock and jams it in the ring so tight it will sometimes pull the punch out of the socket when the sides are too straight. By the arrangement of *J* it can be seen that it is very little trouble to change the punch die and ring, and still keep the same center as when first set. The punch is shown at *C*. A blank for single-end wrench is shown at *L*. At *M* is a blank for double-end wrench as made with these dies.



FORGING-PRESS DIES FOR WRENCHES



FORGING-PRESS DIES FOR RAIL TONGS

Officials of the Great Northern Railway have completed plans for the substitution of electricity for steam for the operation of trains through the Cascade tunnel, one of the longest railway tunnels in the country. The energy for the electric plant will be obtained about 35 miles from the tunnel, where large water power can be developed. By construction of about two and one-half miles of waterway it will be possible to obtain a head of 140 feet, which will supply all the power that can possibly be needed. Under the direction of President Hill the electric plant will be constructed in two sections, each one independent of the other, so that in case of a failure of a portion of the plant, the rest can be used. The Great Northern tunnel through the Cascade mountains is built through solid granite. From portal to portal the tunnel is 14,400 feet long, or between 2½ and 3 miles. The grade is about 1.7 per cent., one end being 240 feet higher than the other. It is possible for trains running down grade through the tunnel to run through by gravity, without the use of steam. When electric service is installed locomotives will still run through it as now, but not under their own steam. The whole train, locomotive and all, will be pushed through the tunnel by electric motors.—*Electrical World.*

New Publications

BUSINESS TELEGRAPH CODE. Compiled by the Business Code Company. 320 4¾x7¾-inch pages. The Hill Publishing Company, New York and London. Price, $7.50.

The code words employed in this system of cipher are formed on the root and terminal system, each root and terminal being employed many times, but in different combinations. The result is great flexibility and compactness, especially in the numerical portion of the code, as by it every consecutive number from zero to 999,999, every consecutive amount in dollars from 1 to 27,999 and every consecutive amount in pounds sterling from 1 to 10,999 may be telegraphed in a single word. Another advantage of the root and terminal system is that in most cases errors of transmittal may be corrected. There being comparatively few roots and terminals, a code word as received may be easily divided into its root and terminal, and the two may then be compared with the comparatively brief list of roots and terminals which concludes the volume. The comparatively small number of roots and terminals makes it possible that they conform strictly to the requirement that they be telegraphically unlike, and thus again reduce the chance of error. While much smaller than most similar publications, the code contains a million and a half coded words and phrases.

MANUAL OF EXAMINATIONS FOR ENGINEERING POSITIONS. By M. H. Lewis and Milton Kempner. 685 6x8½-inch pages. The Engineering News Publishing Company, New York. Price, $5.

The removal during recent years of many thousands of positions in the Federal service as well as in that of many States and municipalities from the domain of politics to that of the merit system, and the fact that many of these positions require expert knowledge which is tested so far as possible by means of examinations, has led to the preparation of this volume of previous examination papers and of typical questions and answers relating to the examinations for civil engineering positions. The book contains several parts or volumes and, while covering more specially examinations for engineering positions in the service of the city of New York, it also includes papers in the civil service of the Federal Government, including the Panama canal and the United States navy, New York State, Boston, New Orleans, and other cities. The book is intended chiefly as a guide to those taking the examinations, regarding the sort of questions which they may fairly expect to be called upon to answer; in addition to this it contains a résumé of those fundamental formulas which occupants of the various positions should have at their fingers' ends.

AN EXTENSION OF THE DEWEY DECIMAL SYSTEM OF CLASSIFICATION APPLIED TO THE ENGINEERING INDUSTRIES. By L. P. Breckenridge and E. A. Goodenough. 72 6x9-inch pages. The University of Illinois, Urbana, Ill.

An extension of the Dewey decimal system of classification to mechanical engineering was published by the University of Illinois several years ago in a small pamphlet of six pages. This pamphlet met with an immediate demand and was reprinted in four editions, each being an enlargement upon the preceding one. The present publication, which is bulletin No. 9 of the engineering experiment station of the university, extends the classification until it has been made to cover with fair completeness the entire ground of engineering industry. The subject of indexing periodical technical literature is one that will not down, and the authors of this pamphlet have done a genuine service in its preparation. The publication follows an extensive trial of the Dewey system in the university, the mechanical engineering department of which has a card index of current periodical literature which now contains 20,000 cards. Experience shows that there is seldom any doubt as to the proper class number for a given card, and for such miscellaneous uses as the filing of blueprints, catalogs, clippings, photographs and other illustrative classroom material the system has been found thoroughly satisfactory. The pamphlet contains a general explanation of the Dewey system and gives all the information needed for its intelligent use.

Personal

J. S. Watson, manager of the Link-Belt Company's drive-chain department, sailed for Europe via the Hamburg-American line steamship "Amerika" on April 25. While abroad Mr. Watson will visit the chain-making plant of Hans Renold, at Manchester, England.

Frederick S. Allen, commissioner of patents at Washington, has tendered his resignation to the President to take effect June 1. Mr. Allen has been at the head of the Patent Office continuously since 1901, and severs his connection with the office to resume the practice of law.

Fred A. Geier, president of the Cincinnati Milling Machine Company, has been elected president of the Bickford Drill and Tool Company, Cincinnati, O., to succeed H. C. Hoefinghoff, recently deceased. Mr. Geier has appointed Frank Huschart his assistant and general manager. Mr. Huschart was formerly with the Marshall & Huschart Machinery Company, Chicago, Ill. He resigned from that firm some two years ago on account of his health and has recently returned from a trip around the world, with renewed health and energy.

Obituary

Thomas B. Riter, president of the Riter-Conley Manufacturing Company, died at his home in Pittsburg, April 23. Mr. Riter was one of the founders of the Riter-Conley Company, this large concern growing from a small machine shop started by Mr. Riter in partnership with John H. Conley.

Business Items

On May 1 the New York office of Robert W. Hunt & Co. was moved from 66 Broadway to the West Street Building, 90 West street.

The Simplex Manufacturing Company has removed its offices to the tenth floor of the West Street building, Cedar and Albany streets, New York.

W. Gerhardi Works, Ludenscheid, Westphalia, Germany are revising their catalog files, and would like to receive catalogs from American manufacturers and dealers.

The Stoever Foundry and Manufacturing Company, Myerstown, Penn., maker of pipe-threading and cutting machinery, has moved its New York office to Room 1101, West Street building, 140 Cedar street.

The Norton Grinding Company, Worcester, Mass., manufacturer of cylindrical grinding machinery, bench and floor grinding machinery, universal tool and cutter grinders, is erecting a building which will double its present capacity.

The Jacobs Manufacturing Company, Hartford, Conn., reports an enormous demand for its drill chucks, making it necessary to run the factory five nights a week until nine o'clock in the endeavor to more promptly supply the demand.

The Norton Company, Worcester, Mass., and Niagara Falls, N. Y., manufacturers of grinding wheels made of alundum and other abrasive specialties, is to erect a large addition to its Worcester works. They will extend the building designated as Plant 2 about 200 feet in length by 111 feet in width, which will more than double the present capacity. This will be fully equipped with kilns, mixing machines, shaving machines, etc., so as to permit of a large increase in output.

Trade Catalogs

D. T. Williams Valve Co., Cincinnati, Ohio. Booklet describing oil and grease cups. Illustrated, 19 pages, 3½x6 inches, paper.

The Bantam Anti-Friction Co., Bantam, Conn. Catalog of ball and roller bearings. Illustrated, 44 pages, 6x9 inches, paper.

T. B. Wood's Sons Co., Chambersburg, Pa. Catalog No. 35, describing friction clutches. Illustrated, 40 pages, 4½x7 inches, paper.

Buffalo Steam Pump Co., Buffalo, N. Y. Leaflet illustrating and describing centrifugal turbine pump and compound duplex mine pump.

The Miami Valley Machine Tool Co., Dayton, Ohio. Catalog of engine lathes and sensitive drills. Illustrated, 15 pages, 6x9 inches, paper.

C. W. Hunt Co., West Brighton, S. I., N.Y. Catalog 072, describing "Hunt" coal-handling machinery, illustrated, 63 pages, 6½x9 inches, paper.

Chas. H. Field, Providence, R. I. Circular illustrating and describing combination mold and ladle for casting soft-metal hammers and vise jaws.

Boston Gear Works, Norfolk Downs, Penn. Catalog B and Price List of standard gears, universal joints, steel balls, etc. Illustrated, 58 pages, 5x8 inches, paper.

The Whitman & Barnes Mfg. Co., Chicago, Ill. Catalog No. 62, listing and describing "Diamond" high-speed twist drills and reamers. Illustrated, 34 pages, 3½x6 inches, paper.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Catalog No. 119, describing blacksmiths' tools and other tools of interest to machinists and repair men. Illustrated, 265 pages, 5½x8 inches, paper.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Catalog B, describing B. & C. friction-clutch pulleys for gas, gasolene or oil engines. Illustrated, 16 pages, 6x9 inches, paper. Catalog C, describing Whitman B. & C. friction clutches and cut-off couplings. Illustrated, 12 pages, 3½x6 inches, paper.

Manufacturers

The Westcott Chuck Company, Oneida, N. Y., will enlarge its plant.

The Sterling Pin Company, Derby, Conn., is building a three-story addition.

The Tilton (N. H.) Optical Company will double the capacity of its plant.

The Southern Stove Works, Richmond, Va., will make additions to its plant.

The Bridgeport (Conn.) Chain Company will build a three-story addition.

The McMyler Manufacturing Company, Warren, Ohio, will erect a new foundry.

The American Cutlery Company, Chicago, Ill., will build a six-story factory to cost $75,000.

The Standard Connecting Rod Company, Beaver Falls, Penn., will erect an addition to cost $15,000.

The Bristol (Va.) Stove and Foundry Company has been incorporated. Capital, $25,000. H. A. Ripley, president.

The Norfolk (Va.) Automobile Company has been incorporated to manufacture automobiles. W. C. Kohler, president.

The Standard Speedometer Company has been incorporated at Kansas City, Mo., by Warren Davis, Brayton Davis and Sylvester De Ford.

The El Paso Lumber Company, Colorado Springs, Colo., is building an addition. Two new dynamos and other machinery will be installed.

The Napa (Cal.) Tanning Company has been incorporated and will erect a tannery. Percy S. King, John P. Evans and M. Sullivan, directors.

The Crawford-Goff Hardware Company has been incorporated at Graham, Mo., with a capital of $10,000. John H. Crawford, C. E. Gow and others, incorporators.

The Schuylkill Haven Iron and Steel Company has been organized and will erect a plant in Pottsville, Penn. F. W. Russell, of Philadelphia, is a large stockholder.

The Hamblin & Russell Manufacturing Company, Worcester, Mass., manufacturers of wire novelties, will erect an additional factory, to cost $13,000, and enlarge the present one.

The McInnes Steel Company, Corry, Penn., will add to its line of product by installing a steel-casting plant, to be equipped with 30-pot crucible furnaces. A new building for this department will be erected. Further additions to this company's plant include a new building for machine shop and forging department and an enlarged power plant, the latter being equipped with two 60-h.p. Ajax gas engines.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Slide rule taught, 322-150 Nassau St., New York.

Caliper catalog free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Fine machine work, tool and model making. Acme Tool Co., 83 Sudbury St., Boston, Mass.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—A machine shop to manufacture for the market a high-grade, large-sized machine. Box 795, Canton, N. Y.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Firm to manufacture and market a developed line of gas engines on royalty, or will sell with patents. Box 937, AM. MACH.

Special machinery to order. Catalog of small engines and boilers and engine castings 10c. Sipp Elec. & Mach. Co., Paterson, N. J.

Wanted to swap a first-class ten horse-power steam engine for lathe, milling machine or drill press. F. A. Bentley, West Point, Miss.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—A responsible concern to place on the market a material for case hardening which revolutionizes present methods. Address "Inventor," AMERCIAN MACHINIST.

Small automatic machinery for special work, models, jigs, etc., built to order. Satisfaction guaranteed. Novelty Engineering Association, Box 264, Fitchburg, Mass.

Arrange with us to do your manufacturing; we build special machinery, special tools, etc. Lewis Blind Stitch Machine Company, 502 North Commercial St., St. Louis, Mo.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Foundry corporation having large contract for automobile cylinders, pistons, etc., desires to connect with progressive machine shop equipped to do necessary machining; no assembling. New England, Care AMER. MACH.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers, 146 West 56th street.

Advice; mechanical, practical and technical; tell me your needs. I'll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y., U. S. A.

The shops of the Motor Car Specialty Company, at Trenton, N. J., in addition to building speed meters and other high-class speed recording instruments, are open for the manufacture of light high-grade machinery, on contract or royalty basis, either in large or small quantities.

A German gentleman; age 30; civil engineer by profession, is desirous of making arrangements with American manufacturers of electrical or building construction machinery for the sale of their goods in Germany; will be in this country about May 1 for a few weeks. Address Box 896, AMER. MACHINIST.

Wanted—Manufacturing rights for article requiring very little machining, preferably none; material to be high-grade grey iron weighing 10 to 300 pounds; something for which wide market can be established; will consider patent, royalty, contract, or Eastern rights. Address "Founder," care AMERICAN MACHINIST.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent wishes to make a change, accustomed to fine and medium heavy interchangeable work; a designer of modern tools, jigs, and special machinery for rapid production. Box 899, AMERICAN MACHINIST.

As superintendent or machine shop foreman; thorough mechanic, up to date, tactful with help; large experience in building machinery; also tools, dies and repairs; best of references. Box 926, AMER. MACHINIST.

Superintendent wishes to make a change; will consider any position of responsibility; a designer of modern tools, jigs and fixtures; familiar with cost keeping system, executive ability and excellent manager of men. Address Box 908, AMERICAN MACHINIST.

ILLINOIS

Russian engineer; (34); of good address; 12 years of drawing office, shop and business experience, both Europe and America; now engaged in this country; desires position as representative or agent for industrial, engineering or commercial firm wishing to introduce or promote American labor-saving machinery in Russia; A-1 references; correspondence solicited Address Box 914, AMERICAN MACHINIST

Situation Wanted—Draftsman, 1 year's board experience on tools, designing for automatic screw machinery, jigs and fixtures; technical education an International Correspondence school course in mechanical engineering; shop practice, 17 years on tools, dies, engine, automobile repairs and general machine work; A-1 reference in both branches; Chicago preferred. Box 925, AMERICAN MACHINIST.

MICHIGAN

Mechanical engineer traveling in Europe this summer wants to correspond with parties desiring informations, reports, representation, etc., of technical nature; has successful experience in this work. Box 889, AMER. MACH.

MISSOURI

Superintendent with record at reducing costs and increasing output can be at liberty June 1; prefer position in Chicago, but would consider proposition in any of the central States. Box 886, AMERICAN MACHINIST.

NEW JERSEY

Draftsman; 5 years on tool design and 4 years' shop experience, desires position. Box 918, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman seeks position. Box 895, AMERICAN MACHINIST.

Draftsman, practical machine designer, wishes to make a change. Box 934, AM. M.

Experienced designer of pumping machinery, reciprocating and centrifugal. Box 912, AMERICAN MACHINIST.

First-class mechanic, experienced on dies, punches, jigs, fixtures, models and all kinds of small accurate work. "Capable," AM. M.

Superintendent of well known concern desires change; good mechanic and executive; has made others and can make your plant pay. Box 917, AMERICAN MACHINIST.

Practical mechanic; technical and business training, with initative and capacity; 17 years' executive experience, wants position as factory superintendent. Box 924, AM. M.

Position as purchasing agent, cost accountant or manager of foundry or machine shop, by high grade, energetic, successful man, with 20 years' experience. Box 932, AM. MACH.

Blacksmith, first class, up-to-date in forging and stamping tools, desires situation where good technical training would be serviceable; would go west. Box 933, AM. M.

Superintendent; age 37; wide experience on interchangeable work, special machinery and metal specialties; executive ability and excellent manager of men. Address Box 802, AMERICAN MACHINIST

Production engineer — cost systematizer, purchasing agent, now assistant superintend-

ent automobile line—desires change; practical and technically educated. "Results," Box 936, AMERICAN MACHINIST.

Expert engineer wishes to spend two days weekly in shop doing heavy work; standardization of tools, belting, feeds, speeds, etc., for increasing output; A-1 references. Box 927, AMERICAN MACHINIST.

First-class machinist, tool and diemaker; 16 years' experience; would prefer a position as inspector or take charge of some experimental work or any position of trust. Box 928, AMERICAN MACHINIST

Technical graduate; machinist with four years' general machine shop practice and five years as electrical and mechanical draftsman, desires responsible position; electrical line preferred in New York city or vicinity. Box 920, AMERICAN MACHINIST.

Mechanical draftsman; 30; technically educated; 12 years in shop and office, up to date on tools and jigs for small and medium interchangeable work; wants responsible position; now employed; will go anywhere. Box 929, AMERICAN MACHINIST.

OHIO

Chief draftsman; up-to-date man; has held such a position and shown good results. Box 921, AMERICAN MACHINIST.

Man with executive ability; good systematizer, experienced on light interchangeable machines. Box 922, AMERICAN MACHINIST.

PENNSYLVANIA

Mechanical engineer and designer; 36 years old; experience, power transmission, textile machinery and tools; is open for engagement. Box 930, AMERICAN MACHINIST.

Wanted — Position as superintendent or shop manager; technical and practical training of 22 years; designed, built and equipped three modern plants; good organizer, systematizer and up to date on modern methods of production. Box 828, AMERICAN MACHINIST.

Responsible position by member A. S. M. E. who has successfully filled positions of machinist, foreman tool department having charge of over 1000 machines, draftsman, designer of special machinery, and superintendent; superintendent of one concern ten years; at present holds position as superintendent; salary $3000. Box 931, AM. MACH.

WEST OF MISSISSIPPI

To correspond with parties wanting up to date instructor in machine shop, forge and foundry practice. Box 923, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Superintendent to take charge of small hardware manufacturing plant, capable of developing into a very large industry; must be a worker, good handler of men and capable of designing tools to produce goods at lowest possible cost; opportunity for ambitious worker. Address, stating salary wanted, to "Canada," AMERICAN MACHINIST.

CONNECTICUT

Wanted—First-class all-around machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Wanted, by large out-of-town manufacturing concern, an all-around machinist; steady employment for the right party. Box 935, AMERICAN MACHINIST.

Machinist wanted to superintend a machine room of 30 men in manufacturing establishment; must be broad-gauge, manly, a good mechanic, and not over 40 years old; executive ability necessary, with a thorough knowledge of designing and constructing new work as well as repairing; a good salary and permanent job for the right man. Write, stating references to C. D. Morris, R. Wallace & Sons Mfg. Co., Wallingford, Conn.

GEORGIA

Wanted—Machinists to work in one of the best shops in Atlanta; good places for good men; open shop. E. Van Winkle Gin & Machine Works, Atlanta, Ga.

ILLINOIS

Wanted—Educated and experienced machine-tool expert in manufacture of gas engines. Ability to handle men to produce best quality goods upon most economical basis. Location near Buffalo. Box 880, AM. MACH.

INDIANA

Wanted—Toolmaker, lathe hands and assemblers; good wages; steady employment; Western Motor Co., Logansport, Ind.

MICHIGAN

Machinists Wanted—First-class machine hands and floor hands on heavy work; steady employment assured. Northern Engineering Works, Detroit, Mich.

Wanted—By an established Michigan gasolene engine manufacturer an experienced draftsman and designer to take full charge of drafting department; applicant must be up to date in factory details, and a hustler; to such a permanent position is offered; state age, married or single, reference and salary expected; communications treated confidentially. Box 915, AMER. MACHINIST.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

Draftsman Wanted — Large lead mining company, 65 miles south of St. Louis, Missouri, wants draftsman for mechanical drafting and for making surface and underground maps; must be first-class freehand letterer and neat workman; man with knowledge of plotting and calculating survey field notes preferred; applicants please submit specimens of work and state salary wanted. Box 867, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Foreman boring mills and milling machines; state fully experience and wages expected. Address Box 910, AM. M.

Wanted—Foreman screw machines; must be familiar with Gridley and Brown & Sharpe automatics; give full experience and compensation expected. Address Box 909, AMERICAN MACHINIST.

Wanted—Lathe and floor hands in the machine shop of a steel works in the vicinity of New York city; steady work and good wages to the right men. Address Box 916, AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Several competent mechanical draftsmen wanted with experience on general engineering and construction work; good positions for the right parties assured; none but Americans need apply; state age, salary expected and give references. Box 861, AMER MACH.

NEW YORK

Wanted—Patternmaker at McEwen Bros., Wellsville, N. Y.

Wanted — Experienced diemaker on drop-forging dies. Box 842, AMER. MACHINIST.

Wanted — Experienced draftsman, toolmakers and machinists; give age, references and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Competent operators for milling machines, boring mills, Jones & Lamson and other turret machines on automobile work. The Lozier Motor Co., Plattsburg, N. Y.

Expert milling-machine hand wanted, accurate and capable of setting up jobs; chance to become assistant foreman if competent. Columbia Typewriter Co., 37 West 116th St., New York City.

Wanted—Several first-class mechanical and eectrical draftsmen. Apply, giving age, experience and salary expected, to Engineer in Charge, Drafting Department, General Electric Company, Schenectady, N Y.

Wanted—Mechanical draftsman familiar with patent office and shop work; must be inventive and capable of making perspectives; permanent position; state experience and salary. "W. M.," AMERICAN MACHINIST.

A small but well established manufacturing company, volume $75,000; dividend 7 per cent., net profit $7700; needs competent man to manage department and invest $10,000 to $25,000; allows full investigation. Address "Factory," AMERICAN MACHINIST.

Manager wanted for large factory located in England; must have successful practical experience in the manufacture of small tools, including high-speed twist drills of the highest grade; also thorough technical and general education and some commercial and executive experience; permanent position and good salary. Apply by letter stating age and experience. Box 911, AMERICAN MACHINIST.

OHIO

Wanted—One machinist experienced on a 3-A heavy Brown & Sharpe Universal Milling machine. State wages expected and experience. Leidecker Tool Co., Marietta, O.

Head draftsman for a Cincinnati machine tool shop of 100 hands; one with experience on radials and turret machinery preferred; state experience and salary. Address Box 913, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Machinists, fitters and machine hands; desirable class of machine tool work. Colburn Machine Tool Co., Franklin, Pa.

Machine-shop foreman wanted to take full charge of all vise work and assembling (small high-grade interchangeable parts in large manufacturing plant; must be able to get the maximum amount of work out at minimum costs. Very good opportunity for the right man. State qualifications, salary expected, and references. Box 891, AMER. MACHINIST.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

For Sale

Test Indicators. H. A. Lowe, Cleveland, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

An established engine lathe business in city of 50,000; reasons to enlarge foundry and limit business to that branch. Address Box 645, Springfield, Ohio.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

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A Dry-sand Mold with a Very Thin Core

An Interesting Way of Making a Mold in Dry Sand, with Its Very Thin Core, the Method of Supporting It and the Pouring of the Mold

The top view of the pattern is shown in Fig. 1, with the core print for main core *A* and two small core prints *B B*. Fig. 2 shows an end view of the pattern with core print *A*. In Fig. 3 is shown the mold cut through the center lengthways with main core *A* in position, partly supported by cores *B* and *C*. Fig. 4 shows the end view of mold with pattern dotted in. Fig. 5 shows the flask lying on the cope, drag up, and the mold dotted in, ready to be stood up on end for pouring, which would be standing on the end *K* of Fig. 3. In Fig. 6 we see the top of the casting, and in Fig. 7 an end view with the core removed.

Figs. 8 and 9 show the manner of rodding the core to strengthen it to withstand the pressure of the iron while the mold is being poured.

The mold for the casting is to be made of what in foundry parlance is termed dry sand, with the mixture of facing composed of two-thirds fire sand and one-third coarse molding sand. To every twelve shovelfuls of sand is added one of flour, and to every twenty shovelfuls one of seacoal. The coarser the fire sand the more molding sand is used, and the better the quality of flour the less is needed. Too much flour will cause the mold to swell and crack in drying, and too little will not give enough bond. The whole is wet up with molasses water containing a little clay.

In molding, the pattern is laid on the board and upset the depth it extends down into the drag by placing under the pattern pieces of board the desired hight, or wedges. The cope is then placed over the pattern and raised so that the joint of the cope will be at the same hight as the lower edge of the pattern; see line *D*, Fig. 3. Thus part of the pattern *B*, Fig. 2, is below the joint and in the drag and the rounding part is above and in the cope.

In making the patterns it would have been much easier for the molder if the parts shown as molded in the drag had been left loose on the pattern and pinned to it. But loose pieces are constantly being lost by the molders, and, to prevent this, many firms will not make a pattern with loose parts if it can be avoided, even if the other form does cost a little more to mold. They claim that the time gained by the molder is on the average lost in the pattern shop through having to hunt up blue prints and remake the lost parts or repair the loose pieces which are broken.

In looking over patterns made in one of the old countries I found that where the patternmaker in this country would make a pattern in two or more parts to

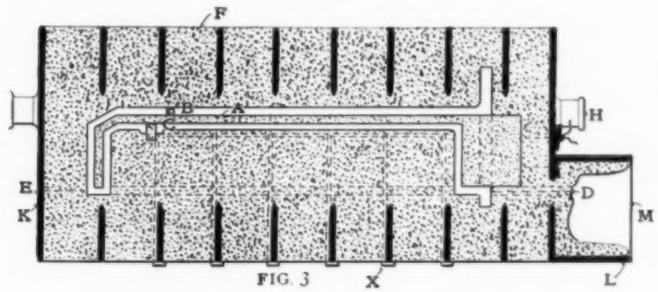


FIG. 3

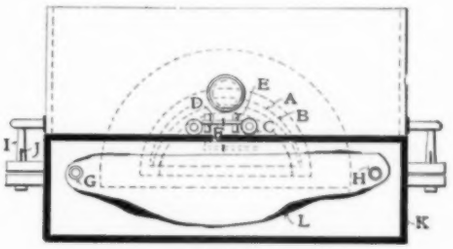


FIG. 4

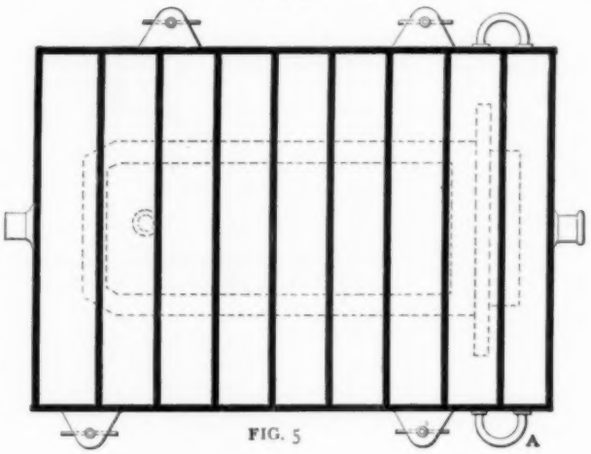


FIG. 5

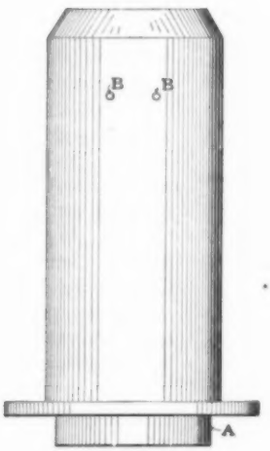


FIG. 1 Top of Pattern

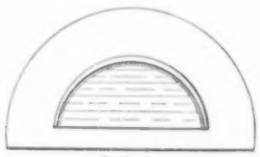


FIG. 7

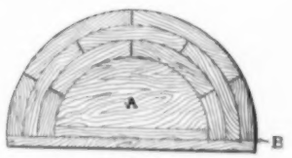


FIG. 2

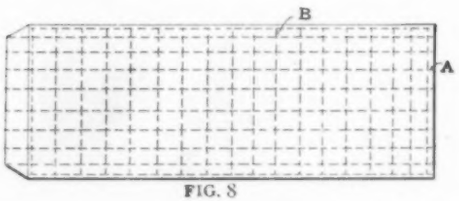


FIG. 8

FIG. 9

MOLDING A CASTING HAVING A THIN CORE IN DRY SAND

facilitate molding, patterns from the country referred to were made in one piece if it was possible for the molder to draw them out of the sand. So I am led to believe that molders in the old country have a few of the bad habits usually accredited to molders on this side of the water only.

But to return, the cope being in place over the pattern, gaggers are set where needed, the cope is rammed up and well vented, rolled over, the joint is made, gate sticks for pouring gates are bedded in the joint *D*, Fig. 3, the drag is put on and rammed, gaggers being set in the inside of the round *X*, Fig. 3, and well vented. Pins *J*, Fig. 4, are driven into flask pins *I*, thus fastening the cope and drag together. The flask is rolled over, pins are removed, the cope is hoisted off by trunnions *H*, Fig. 3, and turned over, the mold is nailed on the joint and the pattern drawn. Both parts are then finished and gated. The mold is given a coat of blacking, slicked, and dried in the oven.

When dried, the cope is laid on the floor

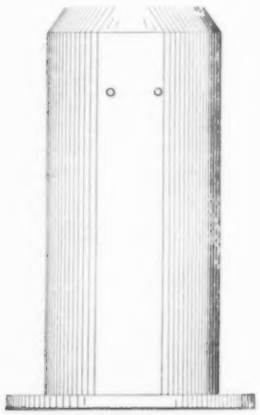


FIG. 6

THE CASTING

joint up, the cores *B* are set extending above the face of the mold a distance equal to the thickness the iron is to be at this point in the casting, and sheet-tin chaplets are set one on each side of these cores. A small amount of paste is spread in the print of the main core *A*, and the core is set in place. The wire *F*, Fig. 4, is pushed through the hole in the end of the mold and flask. It can then be twisted around the rod of iron *D*, and the wedges *E* pushed under the ends of the rod, thus putting a strain on the rod to hold the core in place. Another chaplet is now pushed down between the core, and the side of the mold on each side.

The drag core *C*, Fig. 3, is set, two chaplets placed on each side and fastened to the face of the mold by a brad driven through the hole in the chaplet.

The drag is now tried on to the cope, and being found to bear right, the joint is pasted and the drag closed for the last time. A little bunch of cotton is tucked into each gate hole. Chains are passed through the staples *A*, Fig. 5, and the crane sets the flask on end. The waste is removed from the gate holes and gate sticks placed in them; runner box *L*, Fig. 3, and *K*, Fig. 4, is placed in position, the runner *M*, Fig. 3, is built, the gate sticks are removed, and the mold is ready for pouring.

The casting is poured standing on end, as it takes less to secure the core in place in the mold in that position, and the vent escapes more freely through the holes *C*, Fig. 4, as the iron rises around the jacket or main core. This core is made of what is termed an oil-sand mixture, one part of boiled linseed oil to sixty or seventy of sand, according to the grade of sand used. The rodding of the core is shown in Fig. 8 and needs no explanation.

A core of this kind gives better satisfaction made from an oil-sand mixture than from a flour mixture, as it does not absorb dampness and makes a hard, firm core, which can be easily handled without danger of breaking. It also needs less venting, and will leave the casting cleaner.

In making cores of this kind care must be exercised to have the wires, or rods, well covered with the sand mixture to keep the iron away from them, and to see that the channelways for vents have enough sand over them to withstand the pressure of the iron. If the rods are not well covered the melted iron will eat through the core, burn on and cause trouble. In the case of the vent, if the iron once enters the vent it will follow the channel and fill it up so that no gas can escape; in consequence the core is broken and blown and a poor casting results.

Wax tapers are often used to form the vent channelways. When the core is made they are placed in the core box, where the channel is wanted in the core, and rammed into the sand. In baking, the wax melts in the sand, and is partly burned, or dried out, thus leaving an open channel in the core. The wax tapers can be obtained of any foundry supply house.

The iron required should be very fine grained with some steel chips or scrap added to the mixture. When pouring, have someone draw the vent, as the gas will escape faster if lighted.

The Association of Italian Manufacturers for the Prevention of Accidents in Factories is offering a gold medal and 8000 lire for a system to eliminate the danger of contact between the primary and secondary circuits of alternate-current transformers. A gold medal and 1000 lire are also offered for a hand crane or winch wherein the danger by the rotation of the handles by the descending load is avoided. The appliances are to be submitted before July 31, 1908. Further information may be obtained from the director of the association.

The Artisan School

Professor Sweet, being questioned as to what progress they were making with the Artisan School, replied rather reluctantly:

"It's an experiment, and for fear we might make a mistake we are making haste slowly. While the building will accommodate 20 or 30 boys, we haven't machines enough to accommodate one-third of that number; nor is it advisable to get them until more boys enter, or until the boys we now have get further along, so as to do the better work while new ones do the roughing. And, besides, we cannot get the machines anyway."

Suggesting that we should suppose he would get all the machinery they needed given them, he replied:

"No; while a good many concerns have given outright, or at a low price, machines and tools, from a Pratt & Whitney lathe to drill chucks, it is too much to ask of machine-tool builders; for, if they began to donate tools to schools, there are so many that they could easily give away their entire product; and there seems to be no reason why they should specially favor the Artisan School, except, perhaps, because of its different object, or because, personally, I may have been of some use to them by the suggestion of new things and by advocating better work."

We suggested that the simple frequent mention of a firm in connection with good work in the reading pages might actually have been of more value than a good deal of money spent in advertising.

"Well," he said, "that depends too much on whether the readers believe what the writer says or consider him a crank."

"Well," we said, "they have come more or less to your ideas."

"Yes," he said, "ideas are cheap and only valuable when carried out, and the man who carries them out is entitled to the money, or the most of it."

When we tried to find out what they are doing, he said:

"The boys put up the ceiling, put up the benches, fired the boiler, put up the line and countershafts, set the machines, generated different-size surface plates, are now making vises which are for our own use, on a new plan and better than any I have seen, and they have started on a small trade-school lathe. Besides, they are refitting old machines, and have an old engine to renew."

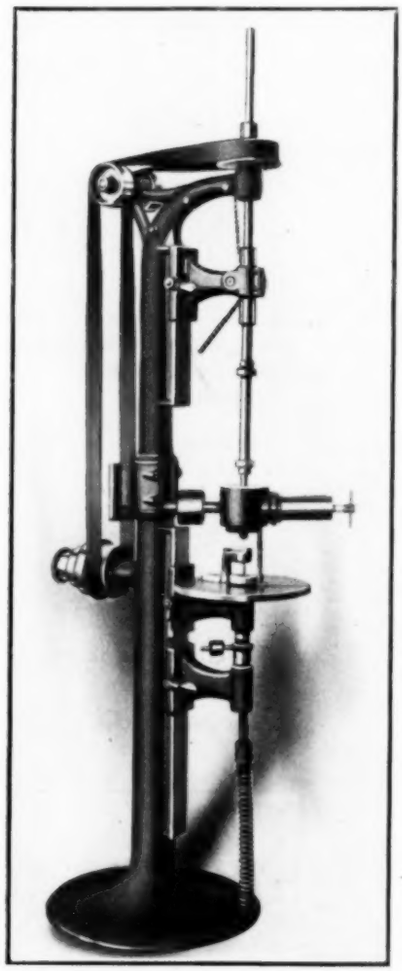
Being asked about getting boys, he said: "We have more applicants than we know what to do with."

To avoid the loss in heating value of coal stored in the open air, experiments have been made of keeping the coal in concrete pits and covering with water until wanted. This has worked very well and, if the loss in open air amounts to anywhere near the figures given by some authorities, it is well worth trying.

Friction of Lard and Machine Oils

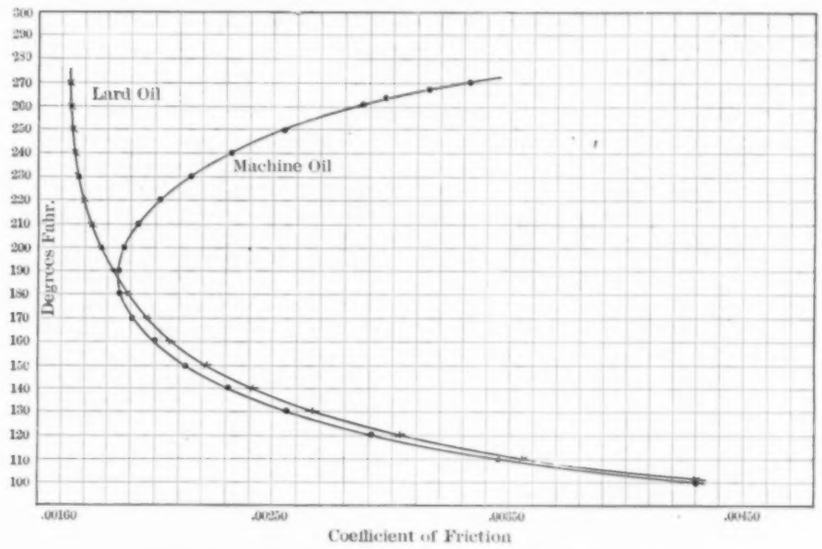
By William K. Jervis

This experiment was run for the purpose of determining the effect of higher temperatures than ordinarily occur upon the friction set up in a given bearing by the oil film between the rubbing surfaces, pressure and speed being maintained constant. The oils experimented upon were common lard and machine oils such as are used for cutting and lubricating purposes. The results obtained are doubly interesting because of the rather extreme conditions of pressure, speed and temperature under which the test was run, and because of the remarkable regularity with which the points, when plotted, fall on a smooth curve.



THE KINGSBURY OIL-TESTING MACHINE

The spindle of the testing machine was vertical and ran between two opposed brasses in a bath of the oil to be tested, which was contained in a surrounding cylindrical case. The load on the bearing was applied by a heavy helical spring passing through the side of the case and adjusted by a screw. The case and its attachments were mounted upon a hollow vertical spindle free to turn on the frame of the machine. The moment of friction of the journal tending to rotate the case was balanced by the torsion set up in a tempered-steel wire by which the spindle was supported, and the displacement of the case was read off in degrees from a circular arc on the frame of the machine. Heat was applied to the case and contents by means of a gas flame.



CURVES FROM FRICTION TESTS OF LARD AND MACHINE OILS

The results of this particular test on lard and machine oils are shown in the accompanying tables.

What these tables show in figures, however, is more strongly brought out by an examination of the curves in Fig. 2. These give the relation between coefficient of friction and temperature of the oil.

Up to about 180 degrees Fahrenheit the coefficients of friction of both the lard and machine oils run very nearly together, the difference being about 3 per cent. in favor of the machine oil. As the temperatures increase, producing a corresponding decrease in the viscosity of the oils, the curves show that the friction coefficients become less, reaching a minimum at 190 degrees for the machine oil, but continuing to decrease as much as 10 per cent. more with the lard oil, the curve becoming nearly asymptotic to the temperature axis and showing no sign of change up as high as 280 degrees.

Evidently above 190 degrees the machine oil disintegrates and the film between the bearing surfaces begins to break down; hence the friction increases very rapidly with the temperature.

Tests Nos. 1 and 2. Speed Machine and Lard Oils. {1020 r. p. m. Total load = 1200 lb. 367 ft. per min. Load per sq. in. = 250 lb.

Tangential pull in lb. per degree twist = 0.0248 lb.

Temp. Fahr.	Degrees Twist.	Tang. Pull of Friction in Lb.	Coefficient of Friction.
	MACHINE OIL.		
100	208.0	5.15	0.00429
110	167.5	4.16	.00347
120	141.0	3.50	.00292
130	124.5	3.09	.00258
140	112.0	2.78	.00232
150	103.5	2.57	.00214
160	97.6	2.42	.00202
170	93.6	2.32	.00193
180	90.4	2.24	.00187
190	90.0	2.23	.00186
200	91.2	2.26	.00188
210	94.0	2.33	.00194
220	98.5	2.44	.00203
230	104.0	2.58	.00215
240	112.5	2.79	.00233
250	124.0	3.07	.00256
260	139.0	3.44	.00287
270	161.0	4.00	.00333
	LARD OIL.		
100	209.0	5.19	0.00432
110	173.0	4.28	.00357
120	148.0	3.67	.00306
130	130.0	3.22	.00268
140	117.0	2.91	.00242
150	108.0	2.67	.00222
160	100.0	2.48	.00206
170	94.8	2.35	.00196
180	91.2	2.26	.00188
190	88.8	2.20	.00183
200	86.4	2.14	.00178
210	84.4	2.09	.00174
220	82.3	2.04	.00170
230	81.0	2.01	.00167
240	80.3	1.99	.00166
250	79.9	1.98	.00165
260	79.4	1.97	.00164
270	79.4	1.97	.00164

RESULTS OF TESTS.

Lifting by Magnet

The lifting magnet is in use at the Greenville yards of the Pennsylvania Railroad, New Jersey, to handle rail and scrap iron, etc. They made a test over in the yards the other day to determine the difference between the old way and the new way. Six men were put to work unloading one car of wheels, while the magnet, which is attended by four men, went to work on a load of exact size, material and weight. The magnet loaded and unloaded its car in one hour, while the six men labored manfully at extra pressure for a half day and were just through. Other magnets have now been ordered, and will soon take their place in the freight yards.—*The Electrical World.*

The New Form of Automatic Assistant Cylinder for Valve Gears *

By Luther D. Lovekin

The subject of assistant cylinders for relieving the forces of inertia and gravity in connection with reciprocating valve gears is one to which the writer has given years of attention, and at this writing 115 of these cylinders are in practical use in various naval and merchant vessels throughout the world.

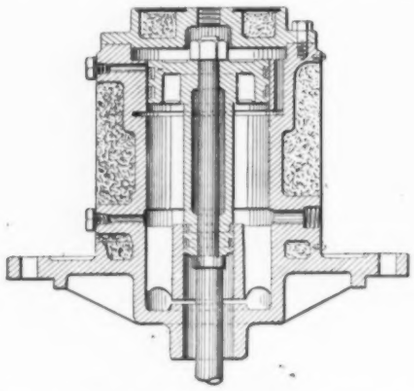


FIG. 1. THE LOVEKIN IMPROVED ASSISTANT CYLINDER, TYPE A

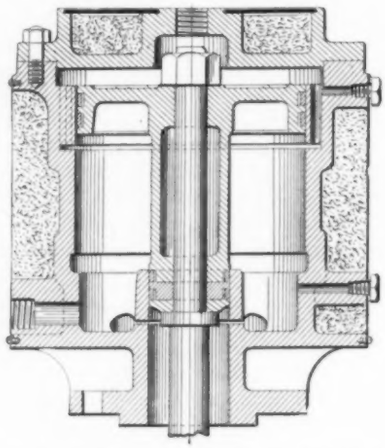


FIG. 2. THE LOVEKIN IMPROVED ASSISTANT CYLINDER, TYPE B

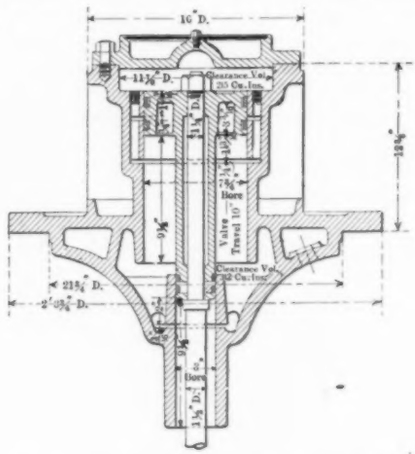


FIG. 3. PRELIMINARY DESIGN OF TYPE E, FOR THE VALVE GEAR OF THE INTERMEDIATE CYLINDER U. S. BATTLESHIP "MICHIGAN"

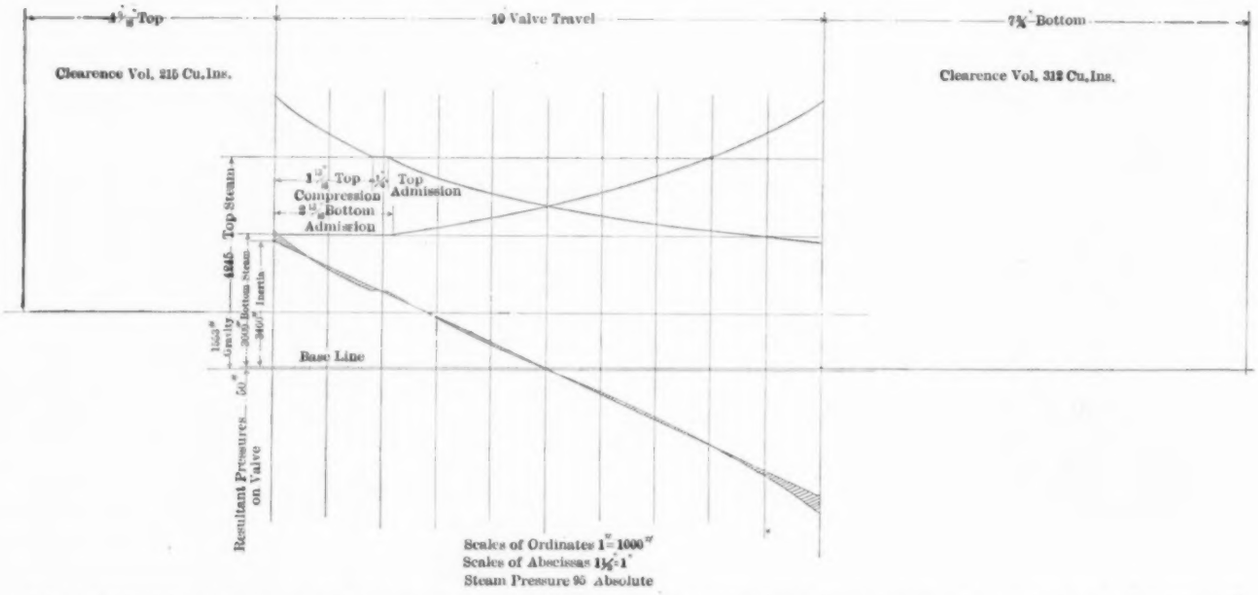


FIG. 4. THEORETICAL DIAGRAM OF TYPE E, FOR THE VALVE GEAR OF THE INTERMEDIATE CYLINDER, U. S. BATTLESHIP "MICHIGAN"

Several forms have been used in order to obtain the best results in each particular case, and, like all other devices which require a thorough scientific investigation being made in order to fully understand the principle upon which it is based, this cylinder has been no exception to the rule of conservatism so prevalent among designing engineers. This is not surprising, when we consider the number of various devices that are brought before the engineer daily for his consideration, and with only a limited amount of time at his disposal for their review.

Being fully cognizant of these conditions, I have contributed from time to time various articles dealing with this subject, so as to bring the entire matter before the engineering world gradually. I believe the time has now arrived when I can safely state that all required conditions have been fully met by some particular form of assistant cylinder among my various designs.

Within the past six months, however, I have brought out a cylinder which embodies the chief characteristics sought for by the designer, viz.: simplicity, economy, automatic regulation, ease of application, and an assurance of the theoretical requirements being fulfilled in practice as closely as possible.

I take great pleasure in presenting herewith a full and complete description of my automatic assistant cylinders, which I hope will be of interest to all concerned. If a further investigation is required, I would refer to the different articles which have appeared at various times, and which I believe form an exhaustive treatise on this subject, viz.: "Assistant Cylinders," published in the *Journal* American Society of Naval Engineers, Volume XVI, Nos. 1 and 3; and Volume XVII, No. 3. Also "Proceedings of the Society of Naval Architects and Marine Engineers," November, 1902 (prize essay).

The Lovekin Improved "Assistant Cylinder" for Valve Gears

Type A—This type, shown in Fig. 1, comprises a valve-chest bonnet and "assistant cylinder" combined in one piece, and is used in connection with an engine having piston valves, which necessarily requires a circular valve-chest bonnet.

It will be noticed that the "assistant cylinder" receives its supply of steam from its own valve chest or receiver, and

*Abstract from the *Journal* of the American Society of Naval Engineers, Feb., 1907.

consequently requires no piping or valves whatever. It is entirely automatic in its action, and has the least number of parts possible to secure the desired results. It is designed in such a manner that the circular steam-inlet port at the lower end serves the purpose of admitting steam from its own receiver, and also forms an automatic drain for releasing any water that might collect in the lower part of the cylinder. The upper end of the "assistant cylinder" is designed to secure the best results in each individual case; the particulars of same are determined by the theoretical diagram (which decides whether no compression top is required, or otherwise.) It is drained automatically, through the ports shown, into the lower part of the "assistant cylinder" and thence to the steam chest below. Both the upper and lower ends of the cylinder are automatically drained during every revolution of the engine.

Piston.—The piston, as will be seen, is of the differential type; the diameter of the lower end being determined by the velocity of steam necessary at the inlet port. Both of these pistons having packing rings of the usual form, and of such width as is found necessary for riding over the narrow slotted ports in upper and lower cylinders as shown.

The conditions of admission and compression are designed for each individual case in order to balance the forces due to inertia and gravity.

It will be noticed that there is no exhaust port whatever; consequently the only steam used in connection with a cylinder of this type is the amount necessary to make up the losses due to radiation and condensation. The principal feature of this design is the ability to form a movable steam-tight packing in the lower cylinder and thus allow compression to be maintained in the upper cylinder. This is accomplished by means of packing rings in the piston, as shown; and necessitates the lower cylinder bore being of a length equal, at least, to the travel of the main valve.

The description of assistant cylinder as given for Type A also serves for illustrating the action of types B and E, as

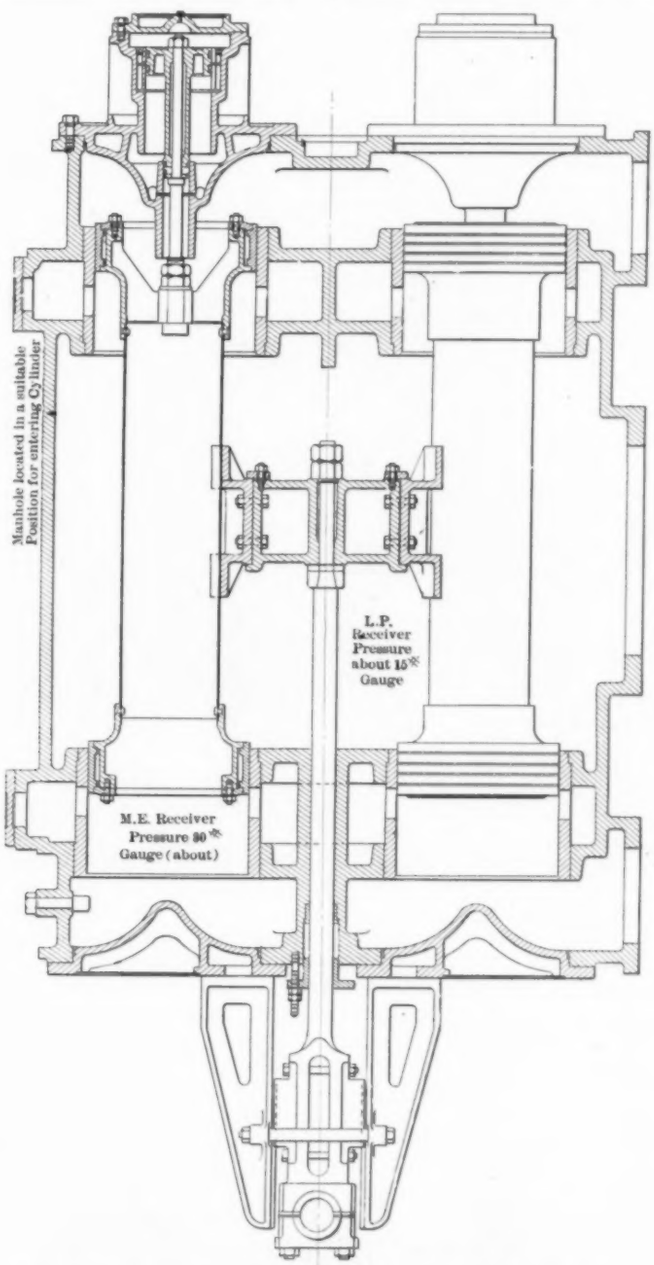

Manhole located in a suitable Position for entering Cylinder
L.P. Receiver Pressure about 15# Gauge
M.E. Receiver Pressure 30# Gauge (about)

FIG. 5. ALTERNATE DESIGN SHOWING TYPE E, WITH INTERNAL CROSS-HEAD, AS APPLIED TO THE VALVE GEAR OF THE INTERMEDIATE CYLINDER, U. S. BATTLESHIP "MICHIGAN"

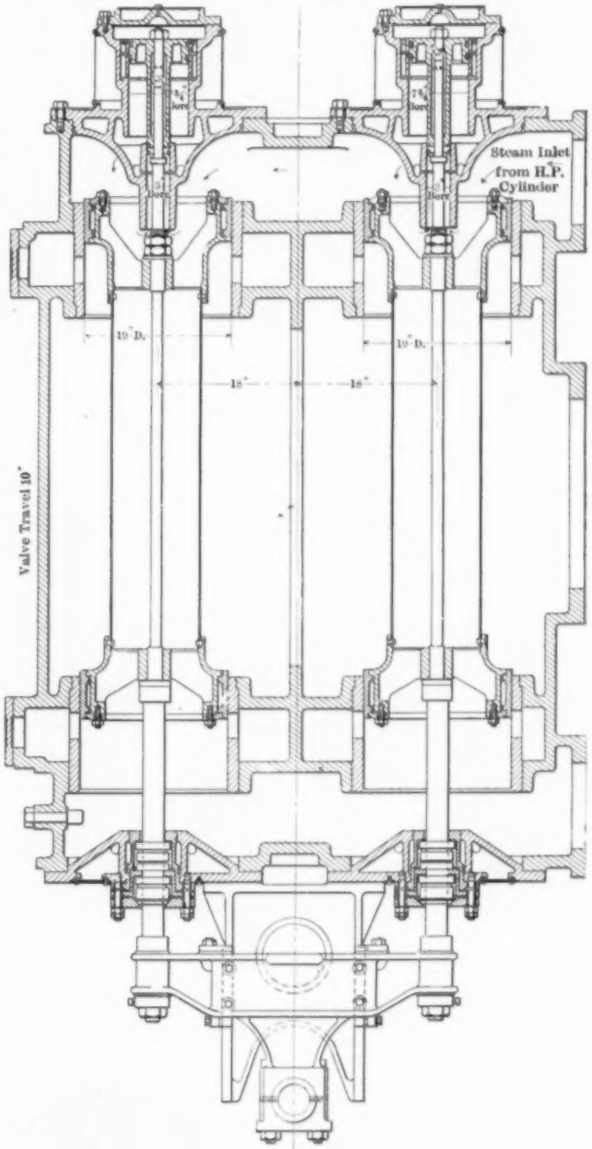


FIG. 6. DESIGN SHOWING TYPE E, AS APPLIED TO THE VALVE GEAR OF THE INTERMEDIATE CYLINDER, U. S. BATTLESHIP "MICHIGAN"

each of these as shown are fully automatic and require no pipes, no valves to manipulate and no complication of parts. They can also be fitted to any engine, old or new.

Type B, Fig. 2, has a cylinder with the same characteristics as Type A.

This cylinder is designed for use in connection with flat slide valves, and is either bolted directly to the steam chest in the event of steam-chest covers being arranged at the end of the cylinder.

Type E (see Figs. 3, 4, 5 and 6) is used in connection with high-speed engines, where the inertia top plays an important part. The chief characteristics are the same as described for Type A.

The Japanese as Mechanics

By A. Gaikoknjn

Do the Japanese show an aptitude for mechanical work? That question has been asked so many times that the suggestion came to me to give some data and let the readers of the American Machinist draw their own conclusion. The accompanying photographs show what one Japanese workman has done, and there are many others.

The ways of doing the operations shown in the accompanying cuts are all the invention (I agree with Entropy, that invention is the offspring of necessity) of a former student of the mechanical engineering department of the Tokyo Koto Kogyo Gakko class of 1905. Though a graduate of the highest school of its kind in Japan, he probably did not have more than 85 hours of actual shop work on machines in his three years of school work. When one compares this time with that which the average American apprentice boy spends before entering on his work as a journeyman, it is surely a very short time in which to develop an aptitude for the work, or indeed derive much benefit from the instruction given in shop practice.

In Fig. 1 will be seen the method devised and used for machining the surface of a cap for a 9-inch connecting rod.

In order to do this work in the lathe shown, a form was first made of an old steel plate *P* in which a slot *A* was cut of the required outline, then the L-shaped guide *B* was made with its end a good sliding fit in the slot *A*. After the guide *B* was securely bolted to the compound slide as shown, the feed screw at *H* was removed and a weight attached by means of a rope to the tool clamps. The regular cross-feed was used for feeding the tool across the face of the work.

Fig. 2 shows a crank-shaft 18 inches in diameter and 21 feet long being machined in a 138 inch swing lathe. The weight of the rough forging for this shaft was 32 tons. When finished it weighed 11½ tons. The throw of the crank *B* was 19 inches and the diameter of the hole *D* 10 inches.

The arrangement shown in Fig. 3 is for planing a curved surface, that in Fig. 4 for finishing the irregular end of a manhole frame, and lastly that in Fig. 5 for milling circular slots. They show so clearly as to need no explanation.

The young man to whom I have referred is about 25 years of age, and while connected with the Kure Arsenal, where the photographs for this article were made, formed a small class of picked men of the works whom he trained very thoroughly, and placed in positions similar to those held by job-bosses in an American shop, so that they in turn

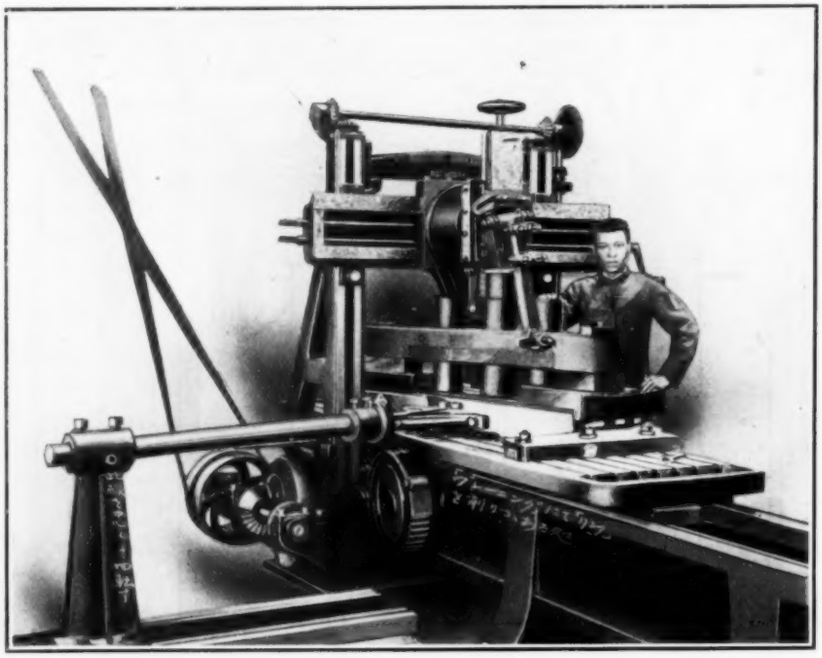


FIG. 3. A JAPANESE PLANER RIG

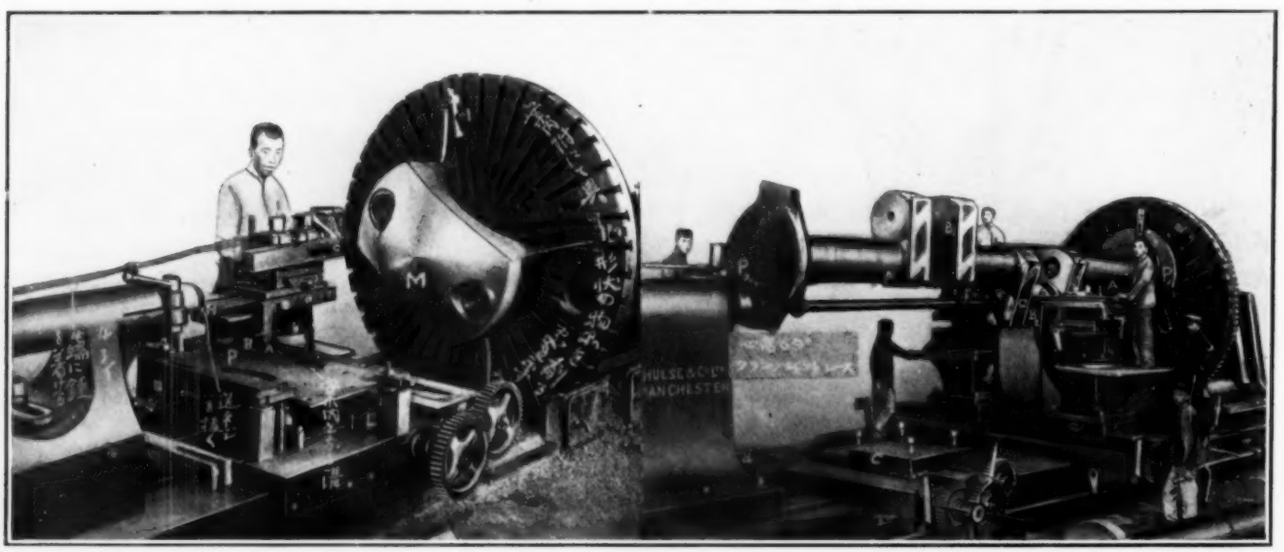


FIG. 1. JAPANESE LATHE WORK FIG. 2.

might instruct the workmen under them.

Furthermore he has in the mean time collected data and written a hand-book of about four hundred pages on improved ways of doing work and the care of machine tools. In fact this book will soon come from the printers. When this is done and he has made arrangements for placing it in the hands of the Japanese workmen, he will sail for America, where he is to enter the employ of one of the leading machine tool builders and work until he has become a first-class mechanic.

Shortcomings of Our Engineering Schools*

By Henry S. Pritchett

In any great general movement men are apt to overestimate the scope and significance of it. Such movements, whether they be in politics or in education, come from the initiative and the leadership of a limited number of men. They are gradually communicated to a much larger body of men, and are adopted into the general work of institutions of learning. From such movements we usually expect more than actually comes, because we underestimate, as a rule, the fundamental tendencies of human nature. At the end of the eighteenth century, men felt that the adoption of republican forms of government meant absolute political reform. Today we realize that the putting of the power of the government into the hands of the whole people was not a final solution of the problem of political efficiency or political honesty. Just so in the introduction of science into the schools fifty years ago men believed that the entire system of education was to be made over and an entirely new spirit of liberalism introduced. It is true that the curricula of our institutions were greatly broadened and opportunities for the education of a larger number of men were opened, but the fundamental facts of human nature were not changed, and there is no reason to believe that teachers in the colleges of technology will be more ready for educational experiments than the teachers in the older colleges, and as a matter of fact they have not proved to be so.

It is today in all our colleges difficult to have an educational experiment tried. It is almost necessary to start a new institution in order to try such an experiment, just as the teaching in applied science might have been done in the old-time college, instead of being done in schools established for that purpose, but for the conservatism of those who conducted the old-time colleges. All this is in marked contrast to the condition which exists in an industrial establishment. In such establishments, as a rule, it is the old and well established institution which tries experiments. A great steel plant with an enormous output may readily devote a small corner of its vast establishment to a new process, while a small and newly started mill would hesitate to risk its future in new methods.

The American college, whether it be of the classical sort or a college of technology, is a conservative institution and is associated with those interests which make for conservatism. The situation furnishes a very wide contrast to that which holds in Europe, where the universities, as for example those of Germany and of Russia, are the centers of new ideas and of liberal tendencies.

Another respect in which the college of technology has not seemed to make good the hopes of its friends in the last decade has been in the matter of scientific research. In all American institutions, whether universities, colleges or technical schools, the spirit of scientific research is relatively weak. The output of energy is in the main directed toward other ends. This is as it should be. The real work of the technical college is to prepare men to be engineers, to be architects, to be chemists, but it will always be true that there should be about this college of technology that which should encourage the spirit of scientific research. Long before this we should have had in each of our stronger schools of technology a real center of engineering research, research which had to do with applied science and its problems. Today such research is almost wholly wanting, or at best is present in our schools of technology in limited degree.

In fact, I should say that the chief weakness of the schools of applied science today is the failure to actually apply science: in other words, the failure to make the fundamental studies, mathematics, physics, mechanics and chemistry, lend themselves in the hands of the student as tools for the working out of practical problems. This lack of successful application is reflected both in the teaching of our technical colleges themselves, and in the relation which these institutions have to the arts and industries. There is no such relation, for instance, between the science of chemistry and the chemical industry, in our country, as exists in Germany.

There is a great difference in the success with which these different sciences have come to be used as tools by our students, a difference which marks great pedagogic distinctions. For example, mathematics and mechanics do not begin to lend themselves as tools with anything like the success that physics and chemistry do, and very largely from the difference in the way of teaching. We have never begun to teach mathematics by the

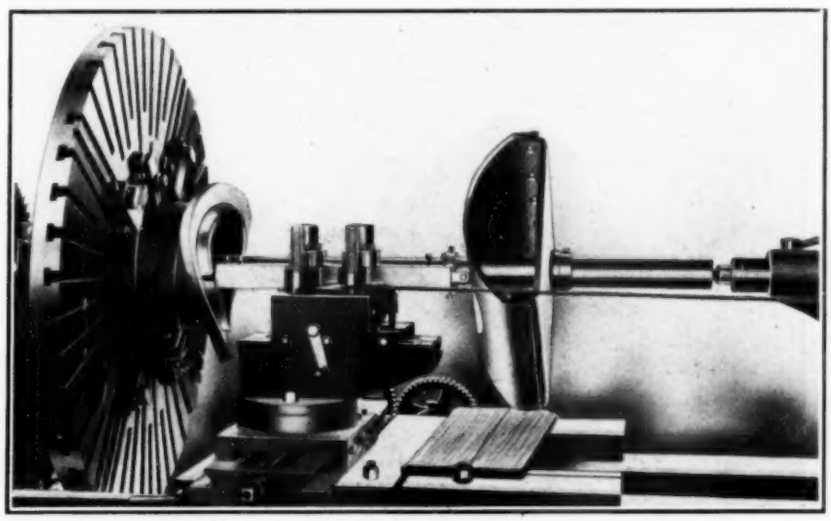


FIG. 4. A JAPANESE TURNING DEVICE

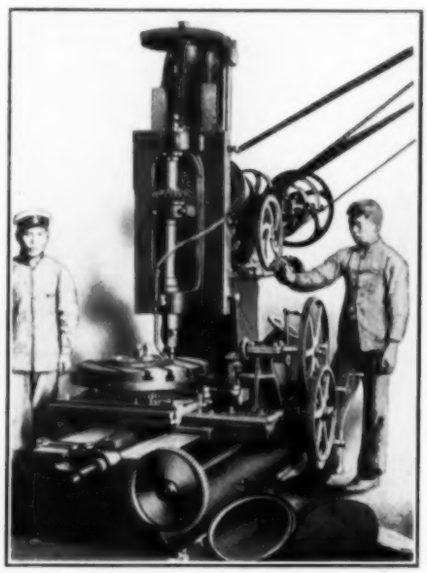


FIG. 5. A JAPANESE SLOTTER OPERATION

*Extracts from an address delivered at the decennial Founder's day exercises of the Thomas S. Clarkson School of Technology.

laboratory method in anything like the practical way in which we teach chemistry and physics.

It is a singular fact that mathematics, the oldest science, still lends itself with least facility to the hands of the student of engineering, and yet it is perhaps the most facile tool which the human mind has ever been able to grasp. Not one engineering student in a hundred makes any use of his higher mathematics after he has left college, and the teaching of mathematics and mechanics in the technical school does not in any material respect differ from the teaching of these subjects in the college of arts. There is no reform in teaching which would accomplish more than a reform in the teaching of mathematics in the schools of applied science.

Ten years ago the schools of technology were being somewhat criticized on the ground that they taught men rather to make a living than to live, that their courses were arranged without regard to the inclusion of humanitarian and culture studies. In response to this criticism, most schools of applied science have added to their courses of study within this period a certain amount of so-called "culture studies." The result which we have today represents rather a Culturkampf than a real gain in the social culture of the students themselves. These so-called culture studies have consisted generally of English, German and French, history and economics. All these are studies of great importance and of real humanitarian and cultural value if studied in the right spirit and under the right circumstances, but their value to the student of the technical college has been of very varying importance, depending partly on the atmosphere of the technical school itself, party on the lack of thoroughness in the secondary schools.

German and French have been assumed to be not only of great value as culture studies, but to be tools in the hands of the students as well. As a matter of fact, they have generally served neither purpose, and have simply added a load to the student's work. The work in German and French is usually of an elementary sort, and could be done as well by the boy of fourteen as by the youth of eighteen. The study is continued in an intermittent way for two or three years, by which time the student has obtained the merest smattering of the language. To call this process a cultural one is the greatest possible mistake and to assume that it gives the student a tool for the reading of foreign languages is equally erroneous. Not one man in a score gets enough German and French to make it of any real value to him afterward.

In an engineering staff with which I am connected, it became necessary recently to have a translation made of a French pamphlet which described an unusual form of gate for a canal lock. It came to my attention that this was about to be sent outside the office to be translated at the cost of $5, and I gave directions that it be turned over to some engineer in the staff to translate. Of the engineers employed, six had had French in college, but only one of the six felt himself able to make the translation. This he accomplished in a fair way, with the aid of a dictionary and a glossary of technical terms. He consumed $18.50 worth of time in the translation. The truth is that modern languages as they are taught have added almost nothing on the cultural sides of the curricula of our schools of technology, and they have added little to the technical preparation. They do not today justify their place in our curricula.

An American company has arranged to build a large branch of its aluminum works at Mille Roches, in Canada. It is said that several large electric power enterprises have also been put through, and that the new steel and iron works at Morrisburg will be in operation within three months, notwithstanding that the Dominion government did not give the desired tariff protection.

Turning 15-foot Disks on a 66-inch Lathe

By J. W. Packer

Some time ago we thought it advisable to undertake to do some work for which we had no suitable tools, and we thought someone might be interested in the way we took to do this work.

Under separate cover we send photographs showing work on tools we had to construct. The problem was to face, turn the edge and finish the seat of several tables used in the grinding of plate glass. They were 15 feet in diameter and weighed about 10 tons each. This is a regular boring mill or pit-lathe job, but we had no tools larger than a 66-inch engine lathe. Now this 66-inch lathe was set in line with a 60-inch engine lathe, so there was a space of about 30 inches between the ends of the beds.

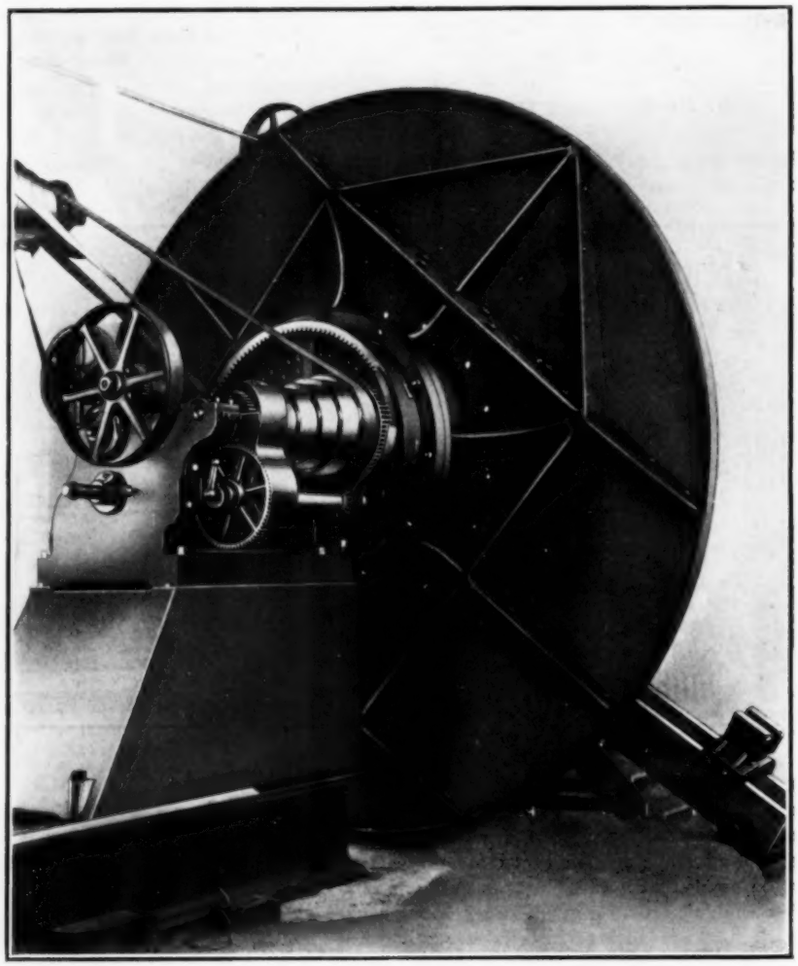


FIG. 1. HEADSTOCK BLOCKED UP AND TURNED AROUND TO SWING DISK BETWEEN LATHE BEDS

By making a casting to raise the headstock of the 66-inch lathe, and *turning it around*, we then could swing the tables in the 30-inch space between the lathe beds, as in Fig. 1. Then by piling up some ex-

tensions we had for the 60-inch lathe at the tail-block end, we had a good foundation for the tool-carriage bed. This was made and secured as shown in Fig. 2. A few pulleys, boxes, etc., rigged in roof trusses to shop, gave us an effective feeding device. The work was done in good shape and in reasonable time.

The only thing about this job that gave us much thought was the fact that the spindle on the 66-inch lathe was only 7 inches in diameter by 12 inches long, and that the work overhung the bearing about 24 inches, making the weight on the bearing about all it could stand with the *best oil fed constantly.*

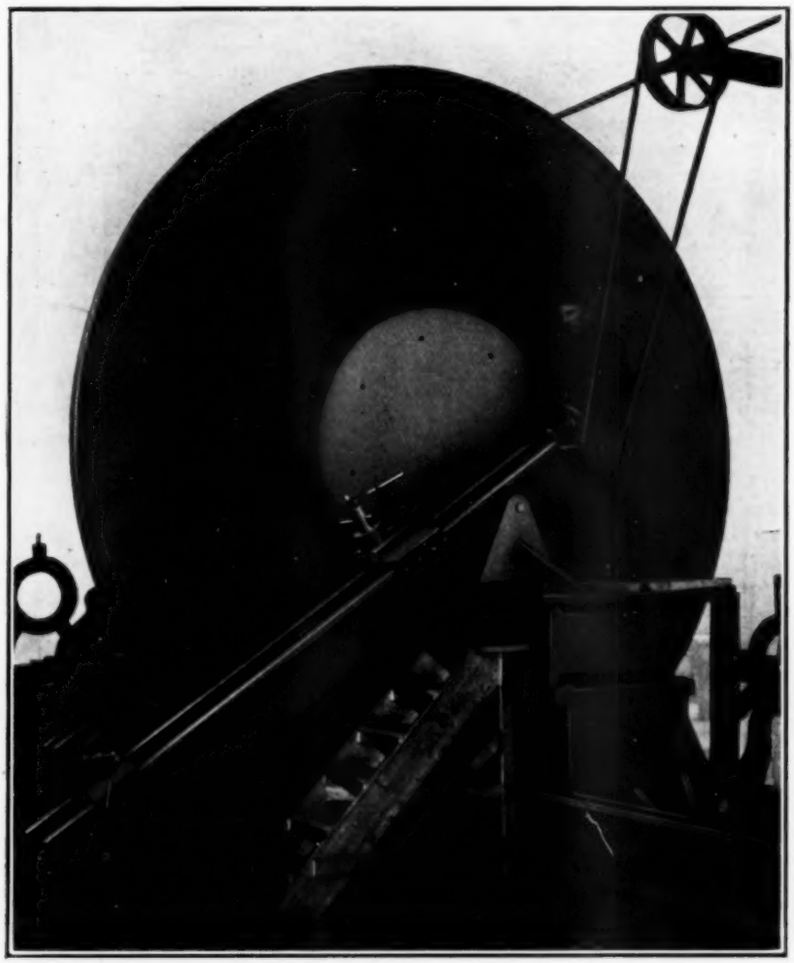


FIG. 2. FACE OF DISK AND TOOL USED FOR FACING IT

In spite of the comparative failure which seems to have attended its operation in Canada, the preferential-trade-within-the-British-empire idea seems to be growing. Preferential duties to the extent of 10 per cent. on certain lines of goods have recently been enacted by the Australian Parliament, subject, however, to the sanction of the British Government. This entire subject is down for review at the next meeting of colonial premiers.

Amos' Observations on a Patent Fire Extinguisher

"Ha! Ha! Ha! Ho! Ho! Ho!" laughed Amos, coming into the engine room and sinking down on the frame of a dead dynamo, with his head resting against a field coil. "What a stupendous joke, hey, George?"

"The other fellow probably doesn't think so," suggested George. "Yet it was a good joke; the drummer was drummed for once."

"Do you think the old man intended to do it," continued George, "or was it partly an accident?"

"Oh, he intended to do it all right. That fellow was sent down by the new purchasing agent, highly recommended; I heard him blowing himself to the old man up in the office. Why, he had the great, the only indispensable protection against fire. It wasn't safe to run the plant over night, or hardly another five minutes, without giving him an order for at least twenty-five of his wonderful putters-out."

"What did he tell the old man he could do with his preparations?" inquired George.

"Why, he said that he could put out any —, any — oh, hang it all! any incipient (that's it) fire which the old man might have started, and not use the contents of more than one of the tubes he had with him. He wanted to bet one hundred dollars that he could do it, but the old man said 'No.'

"He said that he wanted the hardest test possible, and he got a hard one all right. The old man took the bluster out of him, made him look like a kid's busted balloon, and he probably felt worse."

"Well," said George, "when I saw you and the old man and the stranger come through the engine-room door—you with some waste in one hand and a can in the other—I knew something was going to happen. That combination didn't get together for nothing; and when the old man told you to put the waste on the floor in front of the open ash-pit door, with the boiler going full blast, and when you poured on the dope, I got interested. By the way, was that benzine or naphtha you had?"

"Either or both, as you wish," said Amos; "benzine and naphtha come out of the same barrel."

"And then the old man told you to light it, and said to the extinguisher fellow, 'Wait until it gets burning well,' and then you lighted it. The old man was foxy; he let it get warmed up before he said 'go!'"

"Yes," broke in Amos, "and then the fellow pulled out and swung around his little yaller tube of dirt and swished it on the fire, and the fire made a graceful bow at each swish and then came up all the merrier; and he dropped his cigar and pulled off his coat, and got both hands on the tube, and swished this side and then that side, and turned red in the face, and sweat, and swore, and still the fire burned; and finally his powder was all gone, and the fire still burned, and he looked as if he wished he was all gone, too; ha! ha! ha!"

"What did the old man say to him, Amos?"

"Nothing, except, 'How about that hundred dollars?' Then he walked away and the fellow got away as quickly as he could, just like a whipped pup."

"That fellow," said George, "is probably used to a fire in an office cuspidore, or a tin pail, not in front of a 300-horse-power boiler with a 200-foot stack pulling on it."

"Yes," mused Amos, "a man should know at least his own business and how little there is between success and failure, sometimes only a breath of air."

The Board of Regents of the University of Nebraska, Lincoln, recently authorized the expenditure of $100,000 for a new mechanical engineering laboratory building. It is hoped that complete plans may be developed so that the building work can be started in the fall.

Filing System for Technical Information

A Cabinet Provided with Filing Drawers for Clippings, Storage Space for Periodicals and a Comprehensive Card-index System

BY OSCAR E. PERRIGO, M. E.

Every man must have at hand the proper tools for his work. Every mechanical, professional or technical man must not only possess, but use, the tools suitable for his particular profession or trade. To the mechanic this means not only the machines *at* which he works, but the hand tools *with* which he works. To the professional or technical man it means his books, his magazines, his technical reports, and by no means least in importance and practical usefulness, his file of clippings and similar data which he gathers day by day from whatever source he may, and in these present days of sharp competition of brain work as well as the labor of hands, the wise man will make use of all these agencies in becoming the broad-minded man of practice as well as theory and thereby lay the foundation of success, however, much stress we may lay upon the specialization of *men* as well as *machines*, of the working of *brains* as well as *hands*.

Books give us in a convenient and portable form much of the information which we need from day to day, and to which we must frequently refer. There is a vast amount of this information which does not change or need revision from year to year, and permanently bound volumes are the proper receptacle for preserving it. But in a general way they do not contain recent, and certainly not the latest information upon the live, every-day topics, the information that is fresh and up-to-date. For this we must look to the mechanical and technical periodicals. We find these of excellent quality and full of the much needed, practical information, and the modern mechanical journal has one other great advantage over most books. Its subject matter is the work of many minds, and therefore gives us a far more comprehensive view of mechanical and technical matters than would be possible if it were written by a few writers even though they are specially trained for such duties.

However, we find that with the many excellent periodicals of this nature they are very liable to accumulate rapidly on our hands, and soon we have great piles of them, all containing valuable information, but buried in such a mass that what we want at the moment cannot be found. True, we may keep a detailed index of all this matter that we shall be likely to need in the future, but this would avail but little as a labor-saving scheme, since the handling of the hundreds of magazines and papers would involve so much time as to greatly curtail the value of the information sought.

The solution then would seem to be that of clipping out all the articles we should probably need in our particular line of work and arranging them in some convenient manner, so as to be quickly found by means of a suitable index.

For several years the writer had experimented with one system or another without much success. The old-time scrap book proved inadequate in a short time from very obvious reasons, and was discarded. Folders soon went the same way.

The method of pasting articles on cards

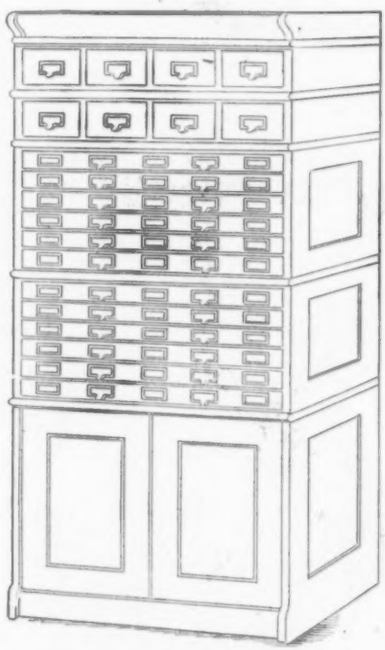


FIG. I. THE FILING CASE

of a uniform size and filing these in cardboard cases, made to resemble books, and having on the back the title of the subject matter contained in each, was a great improvement. But obsolete matter was not readily eliminated, and the cases were soon too full for convenient accessibility. More cases could, of course, be provided, but this soon rendered the whole method unwieldy and complex.

The envelop method came next, but this soon proved cumbersome and inconvenient, and the article desired was not readily found even with the aid of a good index. The envelops were kept in boxes in which they were filed vertically for as ready access as possible. But this arrangement, while an improvement on the previous methods, did not satisfactorily solve the problem, even with a card index. The contents of an envelop, after it had been found, usually had to be emptied out on a table and the clippings sorted to find the article sought, after which the remaining contents had to be replaced in the envelop and the envelop put back into the box in its proper place.

About two years ago the writer constructed a filing case containing drawers for each subject of the lot of clippings. This was described as "A Home-made Filing Case for Clippings," in the AMERICAN MACHINIST, at page 123, Vol. 28, Part I. This case contained thirty drawers 4 inches wide, 3 inches deep and 12 inches long, inside measurements, and four drawers double the width but of the same depth and length. The successful use of this case led to the idea of enlarging its scope and usefulness, which was done in the cabinet shown in Fig. 1.

This cabinet consists of several sections, the lower one being a cupboard with double doors and used for two purposes, first to bring the upper sections up to a convenient hight for use, and, second, to furnish a convenient storage space for periodicals from which articles are to be dipped, and for clippings not yet classified and filed.

Above this are two sections, each composed of six drawers, one of which is shown in Fig. 2. These are divided into five compartments each, the spaces being 4¾ inches wide, 13¼ inches long and 1½ inches deep, and sufficient to hold a column of matter from those periodicals using the wide column, or a full page of either these or the three narrow column page of others when they are folded once. A separate label holder on the front of the drawer opposite each compartment shows its contents.

Above these are two half sections each containing four drawers for regular 3x5 inch filing or indexing cards.

These sections may be purchased, ready for use, except that the divisions in the filing drawers must be supplied. Therefore the system may be commenced upon a moderate scale if desired and expanded at any time and to any extent.

The system for handling clippings of over a quarter of a column in length is as follows: Each compartment in the filing drawers is devoted to a subject or a class of the subject. Index cards are filled out for each article filed, as shown by the index card in Fig. 3, giving on the top line in plain letters the title under which the

article is filed, and following this with the sub-title or any further information or explanation of its nature that may be necessary. Then follows the author's name and the date on which the article was published. The clipping is then filed in the proper compartment in the filing drawers.

Should there be another desirable article printed on the same clipping, say, for instance, on the back of it, its title is given, preceded by the word "also," to indicate that fact. In this case another card is filled out giving the proper title, etc., and beneath is the word "with," after which follows the title on the original card, for the purpose of indicating where this second article may be found. In the same manner a third or fourth article may be indexed.

The method of arranging the guide cards in the index drawers is shown in Fig. 4. The first, or subject index card is blue and gives the subject, in this case "Shop Systems." Then follow the class guide cards, salmon color, with the different classes of the subject, as "Bonus or Premium," "Costs," etc. The labels on the fronts of the filing drawers are lettered the same as these guide cards and the subjects arranged alphabetically, the class labels being of a different color. When the subject is not divided into classes one compartment is sufficient to hold the clippings relating to it. If the subject is divided into classes there is a separate compartment for each.

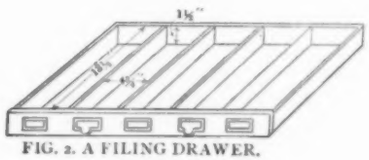


FIG. 2. A FILING DRAWER.

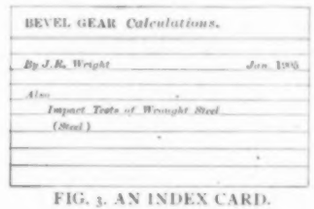


FIG. 3. AN INDEX CARD.

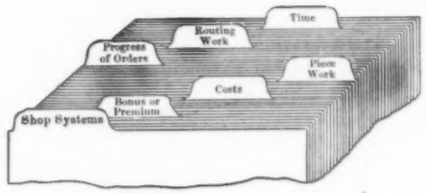


FIG. 4. SUBJECT AND CLASS GUIDE CARDS.

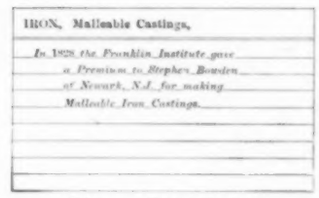

IRON, Malleable Castings,
In 1908 the Franklin Institute gave
a Premium to Stephen Bowden
of Newark, N.J. for making
Malleable Iron Castings.

FIG. 5. A DATA CARD.

DETAILS OF THE SYSTEM

In the illustration, Fig. 1, are shown drawers containing sixty compartments. To properly index the matter contained in these will require two and possibly three index-card drawers. Short clippings are pasted on the 3x5-inch index cards, using both the front and the back if necessary. The proper heading is written similarly to that on the index cards.

Again, there are many items of information, formulas, memoranda and the like that can be very conveniently written on one or both sides of a 3x5-inch card, as shown in Fig. 5. These cards, together with those bearing pasted clippings, are filed together in the remaining index-card drawers, and it will be somewhat surprising how rapidly they will fill up and what a variety of useful information can thereby be stored away for future use. They may be filed alphabetically if desired, but for quick and convenient reference it will be better to file them by subjects and classes, the same as the longer articles, and similar guide cards should be used, as one soon becomes accustomed to the classification and knows just where to look for what is wanted.

In arranging a classification of subjects, they must, of course, to a considerable extent, be handled with reference to one's individual needs. Frequently the verb rather than the noun may be used to advantage for the initial word. Both are used as occasion may require in the following list of subjects which the writer has adopted for present use, but which will doubtless be changed from time to time as circumstances may dictate.

Air. Alloys. Automobiles. Biography. Bolts, Nuts and Screws. Books and Periodicals. Brazing and Soldering. Building. Drawing. Drilling and Boring. Electroplating and Galvanizing. Electricity. Engineering. Filing Systems. Fire Protection. Forging. Foundry. Gas. Gasolene and Oil Engines. Gearing. Grinding. Iron. Lighting, Heating and Ventilating. Lubrication. Materials of Construction. Manufacturing Plants. Milling. Oils. Painting. Patterns. Piping. Planing. Punching and Shearing. Power. Rolling Mill Work. Sanitation. Sawing Metals. Schools, Technical. Shop Management. Shop Systems. Small Tools. Speeds and Feeds. Store Room. Steel. Suppplies. Tool Making. Transportation. Turning. Turret work. Variable Speed Mechanisms. Water. Wood Working. Miscellaneous.

These various subjects, being divided into classes when necessary, will give very full and complete means of reference. There is more danger of having too large a number of clippings in a class than in having too many classes, as a large class will make quick reference more difficult. Classes can at any time be readily increased by adding another section of filing drawers. Those sold for holding legal blanks or electrotypes will be proper for this purpose.

The index cards may also be used as an index to certain matters in reference or text books that are likely to be wanted in the future by filling out a separate card for each article or item of data required and adopting as a headline whatever initial word the user would most likely call to mind in looking it up, that it may be quickly and conveniently referred to. Cross references may be made in case the title of an article seems to make it necessary, but it will be better to avoid this as much as possible as it is very easy to make not only much extra labor, but a cumbersome index.

Obsolete matter should be removed from the filing drawers and index drawers as soon as its usefulness is past, so as not to encumber the filing case with it.

When the clippings relating to a subject become too numerous for the space set apart for it, it should be divided into two or more classes.

Individual Motors for Machine Tools—Why Not Standardize?

By A. L. Pratt

Even a superficial investigation of the sizes of electric motors applied to individual machine tools will show a lack of uniformity for machines of the same kind and size. In some cases the size of the motor used appears to a person acquainted with horse-power values for machine tools to be about right. In other cases such sizes appear like a guess, which is sometimes high and sometimes low. Along this line and while at the World's Fair at St. Louis in 1904, I tabulated the sizes of motors from a large number of the machine tools there exhibited. Some of the comparisons are interesting.

There were three 16-inch by 6-foot engine lathes which had motors of 1 horsepower, 1½ horse-power and 3 horsepower sizes respectively, a variation between the smallest and largest of 200 per cent. There were 24-inch engine lathes of practically the same type having motors of 3, 5 and 7½ horse-power sizes respectively. In another case of two 20-inch engine lathes, one had a 3 horsepower motor and the other a 10. Another instance was among shapers. One 24-inch shaper had a 2 horse-power motor, while another of the same size and type was considered by the maker to require a 3 horse-power machine. Among flat turret

lathes of the 2x24-inch size, one maker put on a 3 horse-power motor, while another put on one of 5 horse-power rating. Another striking comparison occurred among the grinders. One manufacturer used a 3 horse-power motor on a grinder carrying two 20x2-inch wheels; while alongside it another make used a 4.6 horse-power motor for a grinder carrying two 16x2-inch wheels. Still again a grinder having two 30x4-inch wheels was driven by a 5 horse-power motor, while another one having two 24x3-inch wheels required a 7½ horse-power machine, and so cases might be multiplied.

It is not fair to assume that there is any good reason for all of these variations which have been noted, or for the range of the variations. A glance at recent catalogs would seem to show that three years have not done much toward uniformity.

Motor-driven tools are here to stay, and they occupy an important place in our machine-shop life. Cannot some of the contributors to the columns of the AMERICAN MACHINIST send instructive data for motor sizes and ratings for at least the well established sizes and types of machine tools which are often equipped with individual motors? Should not something be done to standardize them in regard to rating?

Correct Use of Datum and Data

BY WM. KENT

For several years, during which the writer held a position on the editorial staff of an engineering periodical and it was part of his duty to revise the manuscripts offered by engineers for publication, he was impressed with the fact that the grammatical error most commonly made by engineering writers was the use of a singular verb with the plural noun "data." Such expressions as "this data," "much data," "little data," instead of "these data," "many data," "few data," were also quite common.

The use of "data is" has become so common lately in technical papers, and even in books written by engineers, that it is apparent that proof-readers as well as engineers need some elementary instruction in the proper use of the language and especially in regard to the plural form of nouns taken directly from Latin and Greek, such as datum and phenomenon. The expressions "memoranda is," "phenomena is," "strata is" are sometimes seen in print in journals which otherwise generally use good English.

All the dictionaries give "data" as the plural of "datum." It may be said that no good writer ever uses the expression "data is," and no good proof-reader ever passes it.

Furnaces for Tempering High-speed Steel

BY C. U. SCOTT

I believe that high-speed steel will take the place of carbon steel; and I am surprised at the hesitancy shown by many in taking hold of it, as I consider it the easiest steel on the market to handle, though I admit this is not the universal opinion.

The hardening room can be fitted up with the very best appliances at a low cost providing you have gas and air (the air to have not less than one pound pressure), 50 fire-brick, two tiles, and some sheet iron, say ⅛ inch thick. In one day's time you can have a complete hardening plant for high-speed steel, and have your work coming from the hardening room as nice as it went in, not fluxed or pitted, but clean and not requiring any more grinding than would be required on any steel. In fact, I have hardened many tools that were used without further grinding. There is little danger of cracking or checking any kind of a piece in the cooling of it; nor is there any danger of causing uneven strains in the cooling, no matter how many pieces you cool at once or whether they touch each other. Pile them in as long as your oil does not get on fire. Of course there is a limit to all things, but should high-speed steel have to be cooled, as is represented by some, a hardening room would be very expensive.

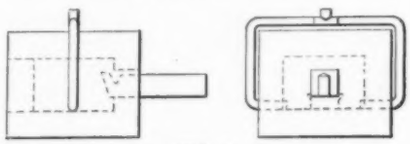


FIG. 1
SMALL FURNACE FOR TOOLS

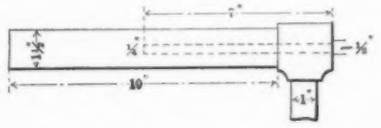


FIG. 2
THE MIXER

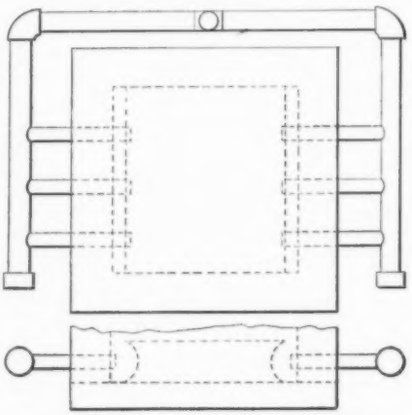


FIG. 3. A GOOD FURNACE FOR GENERAL WORK

FISH OIL IS BEST

Fish oil should be used for cooling the work, and when the steel has received the proper heat do not be afraid of losing it. After it is heated it cannot be forced to spring by cooling as carbon steel can in dipping; hence, as it cannot spring or warp in dipping, then the warp or spring must take place in the heating. If we admit this to be true, and I have tested it thoroughly, all cracks in the hardening room are caused by the heating (unless done in the drawing, which is the most dangerous part of the work done.)

FURNACE FOR SMALL TOOLS

In the hardening of lathe tools I would suggest a furnace such as is shown in Fig. 1, requiring about eight fire brick with two burners of ⅜-inch pipe, at a probable cost of $5. It can also be used for small work. The opening for the tool should be made so that the tool fills the hole, or nearly so. When tools for 1-inch and 2-inch tool posts are to be hardened in the same fireplace a bar of common iron above the tool in the wall of the furnace so as to prevent the heat from going back of the cutting edge. The tool shown in place has only the cutting part exposed to the heat. This is not to prevent the tool from breaking while in use, but to prevent it from cracking in reforging; for if the tool is hard back on the body, even when reheated with the greatest care there will be more or less cracks.

The expansion of high-speed steel is about double that of carbon steel at the hardening heats, and it does not start at the same heat that carbon steel does. So, by turning the steel often and dipping in oil, but at the proper heat, cracking can be prevented, and the checks are very hard to see even with the aid of a strong glass.

Take a piece 1½x½x6 inches, and place in the furnace (such as Fig. 2.) Do not turn, but allow to rest on the bottom of the furnace, and come to a hardening heat. You will find it has sprung 0.020 or more. Heat it the second time, and let it fall on a piece of iron, and you will know why your lathe tools broke.

All pieces that are difficult to harden on account of their shape should be protected by placing a piece of common iron over the thin part to prevent heating ahead of the heavier part of the tool. All tools of any length must be turned often while heating. This is important in annealed as well as unannealed tools; in fact, it is the only way to prevent warping and cracking.

FURNACE FOR LARGER TOOLS

Fig. 3 is a furnace for all kinds of tools, milling-cutter dies, profile cutters,

etc. It can be built so as to make an upright furnace by connecting the gas and air back of the mixer with a rubber hose and having the furnace so it can be turned to an upright position; but the upright furnace shown in Fig. 4 is much better for work, being built expressly for this class of work. This furnace has a heating space or floor of 9x12x6 inches, with a capacity of 350 profile cutters No. 3 shank per hour, or from 40 to 50 pounds of milling cutters; for in using a ¾-inch stream of gas at 4 ounces pressure it is better to have more than one pound of steel to handle. The air from the regular compressor is best, being regulated by a valve the same as the gas.

Much depends on the mixer; and should the air drive the gas back and put your fire out, make a mixer as is shown in Fig. 2. This will do the work to perfection. With a furnace, as shown in Fig. 4, turn on the gas and light; then the air gently. Get the furnace as hot as it can be made before trying to harden tools.

Take a piece of carbon steel, remove all the scale, then try your furnace and if you can heat it to an extreme white heat without scaling it while it is in the furnace, you are ready to harden high-speed steel. It will be found that steel without the scale removed is much harder to heat without scaling and blistering than steel that has been machined. Always have a pair of dark glasses, which should be worn in heating high-speed steel.

Learn by Experience

There is but one way to learn when you have the proper heat. Take a piece of high-speed steel 1x½x8 inches and place in furnace. While heating turn occasionally until it gets white hot to the naked eye. Then watch closely, having sufficient gas so that the blaze comes out of the furnace, and you will notice a shadow pass from one end to the other, or possibly meet in the center and go out. Have the work in but a few seconds after this and you will not find any crack nor will the work waste away or lose size. The oil bath should be directly under the mouth of the furnace, so that the tool will not be exposed to the air any longer than necessary. The furnace should stand at least 50 inches high, so that the tool hardener will not be required to stoop or bend over to look into the furnace. An air pipe placed below the mouth of the furnace, with several small holes drilled in the upper side, will help keep the heat from the hardener.

A Good All-round Furnace

The horizontal furnace shown in Fig. 3 is the most practical furnace for reamers and taps, etc., and should be built in accordance to the work to be done. The heating chamber should be extended past the two lower burners at least 6 inches so as the end of the tool can be passed below the extreme heat, allowing the center and upper part to obtain the proper heat, with the point, and not lose in size or pit and blister. This furnace should be built not over 28 inches high and lower, if possible.

Great care should be taken in heating long reamers, taps, etc., holding them straight and turning them without touching the sides, as this steel is very, very soft. When heated thoroughly you can force a pine stick through a piece brought to the proper heat. In cooling, the reamer or tap should be held as nearly perpendicular as possible; and after immersing in the oil, hold it in the tongs for one minute, or until it has cooled sufficiently to resist its own weight; then rest on its end in the oil and allow to cool, taking out whenever you please so long as you do not force the cooling.

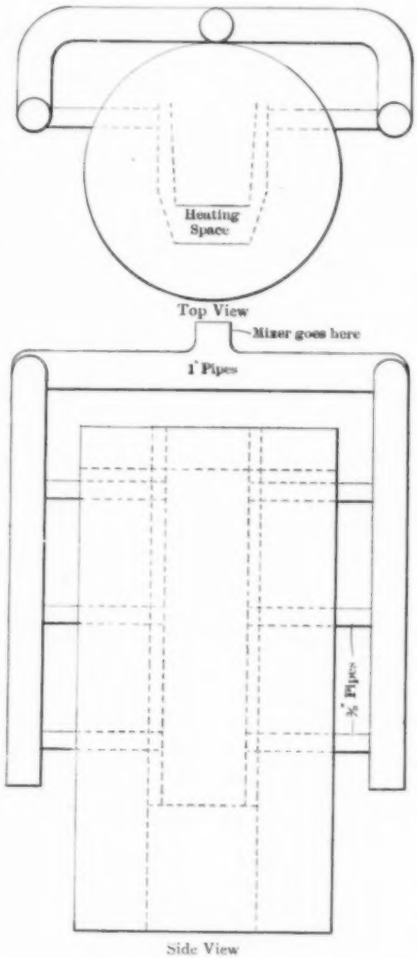


FIG. 4. UPRIGHT FURNACE

It will be found that the tool can be straightened for grinding the same as any other steel; if you are not able to straighten them they have not had the proper heat nor will they stand to do the work that they ought. You will find by leaving the reamer in the fire after it has had the proper heat, say 10 seconds, that it will fly like glass when the strain is placed on it.

Experiment with a Bar of Steel

My advice is to take a bar of round steel, remove the scale and heat to the proper heat, cool as you would an expensive tool, then try to see what strain it will stand. A piece of ⅝ rod 10 inches long should bend ⅜ inch or more before breaking; and when you have learned some of these points then you can try reamers, taps, etc., being sure, after you have built your furnace that you can heat without scaling while in the furnace.

Now as to the tempering of this steel. Take one dozen tools all hardened at the proper heat. Mark six of them with private marks; send them out, after drawing, with the other six that have not been drawn, and note the results.

A Good Test

Here is a test that some might try: Take twelve tools, cooling every other one, as heated, in any compound you may fancy. Put the others in melted lead, allowing the latter to cool until black; then lay them out to cool in the air or put them in fish oil. If the oil is hot, do not mind. If the lead gets red hot, keep adding until you have the six in clean. Then send them out and see which tools are returned, remembering not to draw the tools that were cooled in hot lead. This test should be made without the user of the tool knowing it, being marked with a private mark, the tools hardened in lead receiving the heat I have described. There is a good oil bath illustrated at page 413, but I would add a false bottom about 4 inches from the bottom, so that no work could go below this. I would also place the air above the false bottom and arrange to draw off the water by means of a pipe placed at the bottom of the tank. I have found that the air from a blower will not be sufficient to stir the oil, as it requires more pressure to stir the oil when entering at the bottom than an ordinary blower will furnish.

The Pittsburg Foundrymen's Association is to be guest of the S. Obermayer Company some time in June, the latter company having arranged for a special train to take the association on a tour of inspection to its new plant at Rillton, Penn., a short run out of Pittsburg.

So called Resista-Steel, containing 79 per cent. iron, 6 per cent. manganese, and 15 per cent nickel, is said to be capable of being bent double cold, when cast in 2½ inch bars. When forged its tenacity averages 58 tons and it possesses elongation of from 60 to 70 per cent., which is extraordinary. A peculiar fact in connection with this alloy is that in the event of either the manganese or nickel being omitted the result is an extremely brittle product.

The Cores Used for the Large Dredge Cutter

By John Gregson, Jr.

At page 429 I gave a general description of a large cutter head for a suction dredge, which had been cast in steel by the Pennsylvania Steel Company. On account of the size and intricacy of the casting the details of the molding presented some unusual features.

As stated, there was no set pattern supplied, the mold being built up with nineteen cores made from five different boxes. The general location of these is shown in the sketch.

Core No. 1 was a plain, round core and was rammed up as part of the drag. A level joint was swept on the drag, making the seat for the core No. 3.

No. 2 core came directly above No. 1. At the top it made the lower half of the hub and had a print for the hub core. Thus No. 1 and No. 2 together made the form around which the other cores were placed, one of each being all that was required.

Core No. 3 made the foot and the lower section of the blade. The inside of it conformed to the shape of 1 and 2; the outside was straight. Gages were made from the print in core No. 2 to both ends of the blade, to insure the right distances. A slot was cut in the bottom of each core, about 3x1½ inches, to remove dirt which might fall down the blades, and the slot was stopped off with a core after the mold was assembled.

When Complications Began

This much of the work was perfectly simple, requiring no special rigging, and was put together before starting the remaining cores.

Core No. 4 made the top of the blade and the hub. Each core, however, instead of making one blade, made the front half of one and the back half of the next, i.e., each core rested on half of two of the No. 3 cores, straddling the joint; and each core after the first one completed one blade and half of the next in order. The last core placed matched up with the first to close the mold, but it had to be made in two pieces on account of the spiral of the blades and in order to have the two pieces drop into place without any friction or twisting.

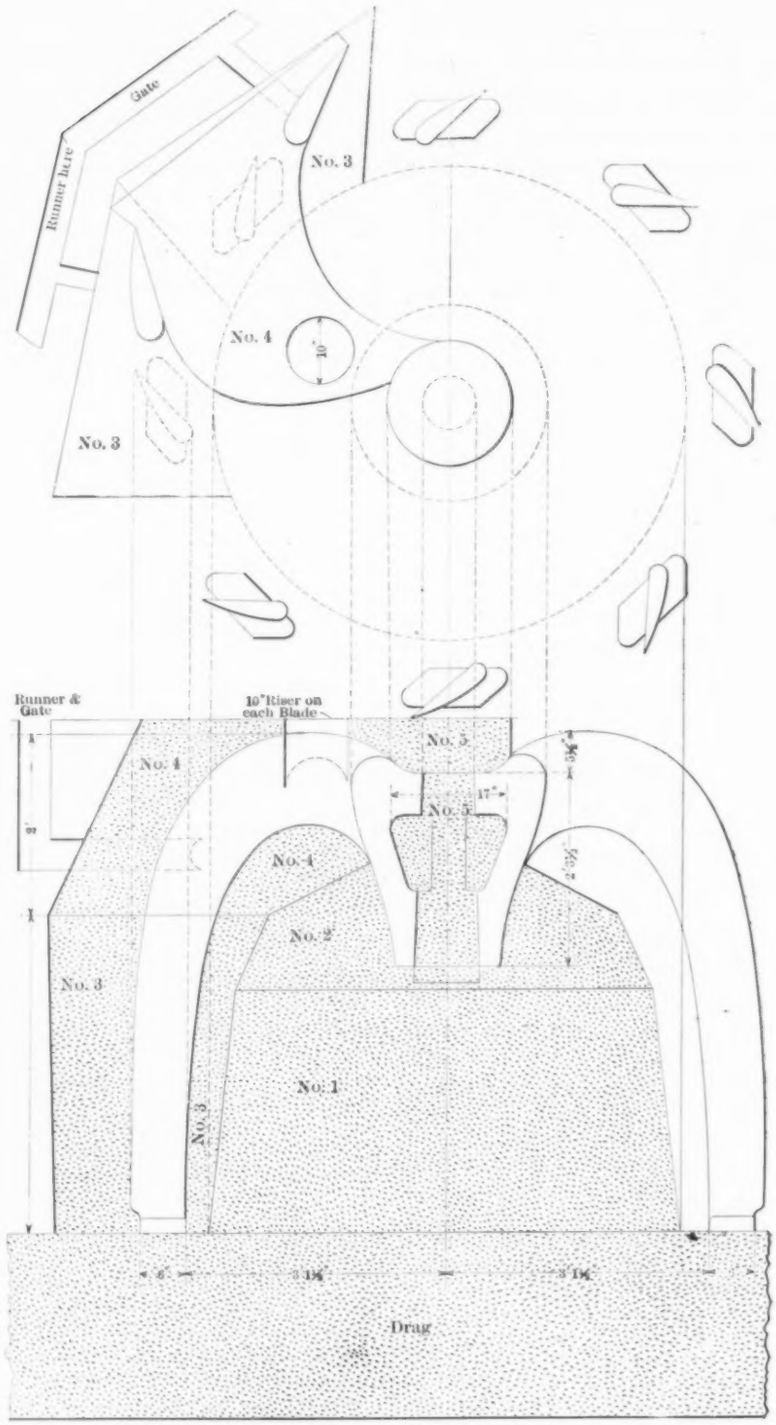
Handling a Weak Core

The chief difficulty with the core No. 4 was to get it strong enough to be handled in the position in which it went into the mold. The bottom was much smaller than the top and there was an overhang in two directions. One view of the core looked very much like a capital F and the other like the top half of a C.

A core plate was made, to which a lifting hook was fastened at each end. A third hook was fastened to a heavy iron rod bent to the general shape of the overhang, and secured directly to the core plate at both ends. The whole core was rodded and tied in every way. After the core was in place, its exact location was observed by looking down the blade from the hub opening. Any necessary patching was also done in that way.

Feeding Heads

In each of these cores a hole was left for a feeding head at the highest point of the blade, and about 6 inches above the joint was a sprue which connected with the main gate. This gate was made in cores which ran entirely around the mold and was rammed up in the backing. In that way the entire great casting was poured from one corner of the flask into each blade at the same time.



HOW CORES WERE SET FOR MAKING LARGE DREDGE CUTTER

It is interesting to note that the circular trough thus formed pulled apart at least 3 inches at the opposite side of the ring from the runner.

Core No. 5 was to have been the last in place, but through some oversight the opening left at the top was too small for the chamber. This mistake was discovered in time for the core to be placed after the third of the No. 4 cores. The arrangement had the disadvantage of closing the mold completely with the setting of the last No. 4. By this time, however, the amount of trimming necessary was pretty well understood and no harm resulted.

Finishing the Job

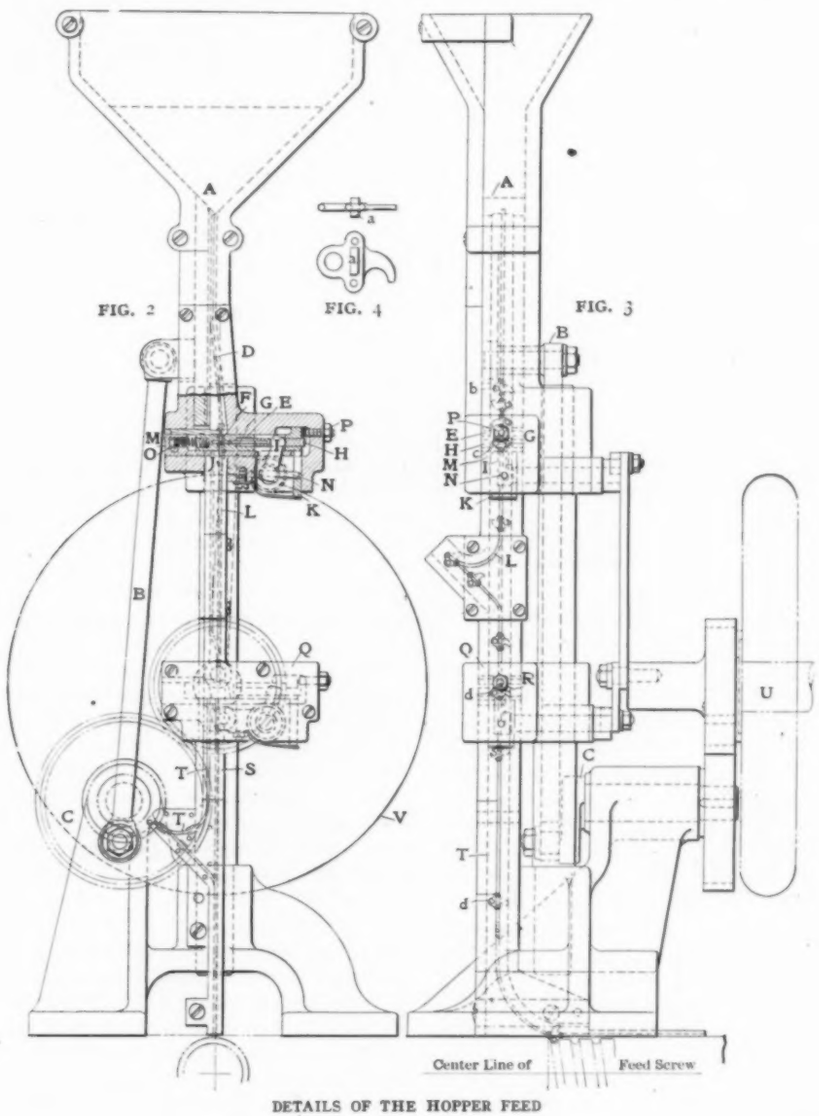
All that was left then was to place the 12-ft. square block in position on the drag, ram it up and weight it down. The pouring left nothing to be desired, as the vents taken away through the backing came off perfectly.

It is not claimed that this arrangement is the best possible, for there are several changes that could be made to advantage in the construction of the boxes. Nevertheless, the first and only casting made by these methods was perfect, a fact which is greatly to the credit of E. Francis, who directed the construction of the core boxes and superintended the assembling of the mold.

An Automatic Hopper Feed

By Nutmeg

In connection with my experience with automatic machinery in the Nutmeg State, many and various hopper feeds were devised; among them being the one shown by the accompanying illustrations, for feeding the peculiarly shaped hooks, shown assembled in the half-tone at Fig. 1. This forms a fastening or closing device for skirts, leggins and other articles of dress.



DETAILS OF THE HOPPER FEED

In the drawings, Figs. 2 and 3, will be seen the cast-iron hopper at the top, made in two parts to facilitate casting and machining at finished points inside, and with the lower end terminating in an enlarged portion forming a case for the "cut-off" mechanism, and a boss for securing the hopper to the supporting column.

Operating within the hopper is a steel blade *A*, grooved on one face to receive the raised rib on one side of the hook (see *A*, Fig. 4). This blade is operated by the connection *B*, and the rotating crank *C*, and so agitates the hooks in the hopper as to keep them feeding slowly down between the blade and the hopper body, by way of the inclined groove *D*, and in one of the four positions shown dotted in Fig. 3, as far down as the top of the cut-off slide *E*, Fig. 2.

Sorting Into Right Position

The next operation is to arrange all the hooks in the track with their hooked portion to the right and eye to the left, as at *b* or *c*, in Fig. 3; this being accomplished by the mechanism shown in section in the case in Fig. 2. The cut-off slide *E* has a vertical thickness just equal to the vertical hight of the hook being fed; and is provided with an opening at *F*, which, in plan, is a free fit around the hook, allowing it to drop into the slide at the proper time.

FIG. 1. INTERLOCKING HOOKS FOR DRESS SKIRTS

This slide is not positively operated at each stroke of the mechanism, but only at such times as a hook happens to fall in one of the correct positions, *b* or *c* (hook to the right and eye to the left), in which case the effect is as follows: The small plunger *G* (Figs. 2 and 3), is fastened rigidly in the small slide *H*, and operated by the lever *I*, the lever and connection at the back of the case, and the rotating crank, clearly shown below, is arranged to pass through the opening *F* at such a position that it will strike the hook point (see Fig. 3); its pressure carrying the entire slide *E*, together with the hook, to the left until in line with the straight

track *J*, when the slide is locked by the bolt *K*, for a sufficient length of time for the hook to fall into the straight track.

Turning by a "Y" Switch

If the hook falls in either of the opposite positions shown in Fig. 3, with the eye to the right, the plunger *G* passes through the eye, allowing the slide *E* to remain stationary, and the hook to fall out of it into the "switch" track *L*, as the mechanism returns to the position shown, where, by gravity and without mechanism, it turns itself to a position with the hook to the right as required, and as indicated on the drawing.

The large slide *M* acts during these operations, to support the column of hooks in the hopper track, and to prevent the hook in the slide *E* falling, until placed over the proper track below. The locking bolt *K*, is forced upward by the flat spring shown, and drawn down for release, by the pin *N* in lever *I*. The spring *O* returns the slide *E* to its normal position against the stop screw *P*; also forces the slide *M* to follow the lever *I* in its travel to the left.

Having arranged all the hooks with their points to the right, it is now necessary to pass them through a second mechanism, which will turn all points downward, as shown at *d d*, Fig. 3.

Still Another Switch

The second device is contained in the casing *Q*, and is a duplicate of that described above, except that the small plunger *R*, Fig. 3, similar to *G* in the first mechanism, is so located that it either passes over the hook point or strikes it. If it passes the hook, the latter is allowed to fall down the straight track *S*, Fig. 2, in its correct position. If the plunger strikes the hook, it and the slide are carried over until the hook is in position to fall down the switch track *T*, and be turned over, as in the upper switch, except in a plane at right angles to that described in the first turning.

Feed Screw Carries to Machine

It will now be seen that all the hooks are in one plane, and with their points all one way, ready to be drawn from the lower track by the large feed screw, shown in dotted lines at the bottom, and carried along to the mechanism which assembles them with their wire links, as shown by the half-tone, Fig. 1.

The entire feed stands on the bed of the assembling machine, and is operated from the main shaft *U*, of the machine, through the gears, cranks and connecting rods, shown. At *V* is an outline of the hand wheel on the assembling machine.

It was found that the parts of this feed worked well at a speed of about seventy revolutions per minute of the main shaft, and kept the track well filled with hooks in their proper positions for assembling.

I have not considered it necessary to go into the details of the materials and exact method of construction of the parts.

It is sufficient to say that the smaller parts of the cut-off mechanisms should be made of tool steel and hardened when necessary, and due care exercised in fitting; this being obviously necessary in such a delicate mechanism.

The Strength of Cast-iron Cut Gears

By H. T. Millar

In all formulas relating to the strength of cut gearing, the permissible safe stress is assumed to be independent of the pitch and the size of the gear. Different formulas covering perhaps different classes of work assume various safe stresses; but

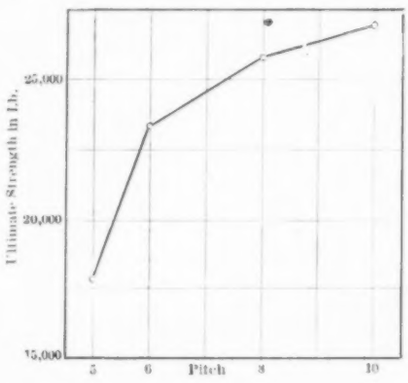


DIAGRAM OF STRENGTH AND PITCH FOR CAST-IRON CUT GEARS

no formula admits that the safe stress may vary with an alteration in pitch.

I believe, however, that with cast-iron cut gears there may be such variation and that the permissible safe stress may be dependent not only upon the size of the gear, but also upon the size of the teeth, or the pitch.

On page 118, in Brown & Sharpe's treatise on gearing, there is given the average breaking load for a number of cast-iron gears of different pitches. They are:

Pitch.	Width.	No. of Teeth.	R. P. M.	Breaking Load.
10	$1\frac{1}{16}$	110	27	1,060 lb.
8	$1\frac{1}{4}$	72	40	1,460 lb.
6	$1\frac{5}{8}$	72	27	2,220 lb.
5	$1\frac{7}{8}$	90	18	2,470 lb.

To these breaking loads the Lewis formula has been applied and a value in place of the factor *S* obtained, which is the ultimate strength of the material, upon the assumption that the Lewis formula is correct for these gears. The Lewis formula was used because it takes into consideration more variables than other formulas. These ultimate strengths are here tabulated:

Pitch.	Diameter of Gear.	Ultimate Strength Obtained from Lewis Formula.
10	11 in.	27,800 lb.
8	9 in.	25,800 lb.
6	12 in.	23,400 lb.
5	18 in.	17,800 lb.

The values are shown plotted in Fig. 1. It will be seen that while the curve rises with a decrease in pitch, the value for the 5-pitch gear, which is the largest, lies much below the probable curve. It would be interesting to be able to follow these experiments up to coarser pitches, for while the above values are given as averages of a number of tests and point decidedly in the direction indicated, they are hardly numerous enough to be considered conclusive.

The A. S. M. E. reports on the strength of cast iron seem to shed some light on the cause of the decided variation in the ultimate strength of these gears; though it must be admitted it hardly accounts for such differences as are noted above. The reports show that the strength of cast iron varies throughout a casting. It is stronger the nearer it is to the exterior, due to the more rapid cooling, which produces a closer grain. It is also shown that for the same reason the iron in a large casting is not as strong as in a smaller one.

These facts influence the permissible safe load of a gear in two ways. The iron in a cast-iron gear of say 40 teeth 1 pitch is probably not as good as that in a gear 40 teeth 3 pitch, which in turn will likely have a lower ultimate strength than that in a gear 40 teeth 8 pitch, assuming, of course, that they are poured from the same mixture. The difference in strength is due to a variation in size. Gears of the same size but of different pitches may also vary. A gear tooth is a cantilever, and when loaded the metal near the root bears the greatest stress and determines the safe stress which may be used. As has been pointed out, the farther from an exterior cooling surface of a gear the poorer is the metal and the lower the ultimate strength. The coarser the pitch of a gear, and consequently the deeper the tooth, the farther will the root be from the exterior and the weaker the iron, other things being equal. That is to say, the iron at the root of a cut gear 3 pitch will probably not be as strong as that at the root of a 6-pitch gear, though the blanks might be of the same dimensions.

From this it would seem that for a gear of given dimensions a decrease in tooth pitch increases two factors in the Lewis formula: *S*, by increasing the strength of the iron at the root of the tooth; and *Y*, by improving the shape because of the number of teeth in the gear. With pinions of small diameter a decrease in pitch with the corresponding increase in the number of teeth might actually strengthen the gear.

The benefits derived from the practice

of casting tooth spaces in castings for cut gears of large pitch might be mentioned. Apart from any gain in machining the teeth, they will wear better and be considerably stronger than those cut from the solid; due to the surface of the teeth being in closer proximity to a cooling surface in the mold.

The ultimate strengths computed from the Lewis formula are low in comparison with the average ultimate strength of cast iron in small castings. A gear tooth breaks through bending, and as has been pointed out in recent discussion, the ultimate strength of cast iron in tension through bending is considerably higher than that of pure bending. An average ultimate stress of cast-iron test bars tested in bending is about 38,000 pounds per square inch. Thus for these gears, at least, the Lewis formula has a low factor of safety. Calculating the permissible loads for the above gears, taking the factor S equal to 8000 pounds, the stress generally used, the following working loads are obtained. The actual breaking loads and the factors of safety are also given:

Pitch.	Working Loads, Lewis Formula.	Actual Breaking Load.	Factor of Safety.
10	314 lb.	1,060 lb.	3.4
8	450 lb.	1,460 lb.	3.2
6	760 lb.	2,220 lb.	2.9
5	1,110 lb.	2,470 lb.	2.2

It need hardly be pointed out that some of these factors are not large enough to be called safe.

Eight 72-ton single-phase electric locomotives have been ordered from the Westinghouse Electric Company for the Spokane & Inland Empire Railway Company, of Washington. This railway, which runs from Spokane, Wash., to Lockport, Idaho, a distance of 130 miles, was one of the first in this country to adopt the alternating current single-phase system. It began operations over a year ago with seven single-phase electric locomotives, operating express, local and freight trains, and the phenomenal growth of business is well shown by this new order for an additional equipment of eight locomotives.—*Engineering News.*

Repairing a Heavy Crank-shaft in a Small Shop

The crank-shaft of a good-sized engine broke down, and as usual it was needed in a hurry. One crank-pin had broken where it was let into the cheek of the crank, and the size can be judged from the fact that the pin was 8 inches in diameter and the whole shaft weighed 5000 pounds.

It was a double-throw crank, as shown in the sketch, the pins being reduced where they went into the cheeks, and the broken end remained in the cheek. This was bored out with considerable difficulty, in the biggest lathe in the shop; but the interesting part was forcing in the crank-pin with the facilities at hand.

The shop is on the second floor of a large building and has no regular forcing press. So the two pieces of the shaft were blocked up from the floor a little, the 2-inch steel bolts used to strap a jack against one cheek as shown, and the rig for forcing in was ready.

REPAIRING A HEAVY CRANK-SHAFT

But it is one thing to force a crank-pin in and quite another to have it true, and it would be hard to say which is the more important.

A stand, or frame, was fastened to the floor at each end of the shaft as shown, and three lines of fine piano wire $A\,A$, $B\,B$ and $C\,C$ stretched at equal distances from the main parts of the shaft. Using these as guides, the two end bearings were lined up by measuring at such points as $X\,X$ in both views, and then the forcing in was commenced.

Measurements were taken at frequent intervals and any tendency to get out of line was at once corrected by applying a little outside pressure at different points. This corrected both "cocking" and "twisting" errors, and when the crank-pin was finally home it was true in all directions within very close limits.

A hole was then tapped so as to be half in the cheek and half in the small end of the pin, as at P, as a safe-guard against turning, as they are not anxious for this job every day. It was done in the shops of L. Wright, Jr., Newark, N. J.

The Edison Drafting School at Schenectady

The General Electric Company at Schenectady maintains a drafting school for young men who desire to become draftsmen. The young man is first required to pass a very stiff examination in arithmetic, the chances being that he will fail; but he is given another trial. After passing this examination, he is admitted to the blue-print department, where about three months are spent learning the ins and outs of blue printing by arc lamps.

Then he is transferred to the tracing department, where he almost invariably becomes an expert tracer before the nine months, completing his first year, are finished. Thus far his working hours have been a comfortable 8-hour day.

The Factory Course

In the second year he is placed in the factory for a year. Usually he is transferred every three months, but there are exceptions to this rule. The work in the factory embraces switchboard assembly and details, oil switches, searchlights, transformers, induction motors, machine shop, test experimental, turbine and many other equally interesting departments of manufacture. Ten hours is the average day's work in the factory.

After his second year is completed the young draftsman, with many advanced ideas as to machinery and electrical apparatus and not a little experience, is now admitted to the drafting room for two years, which completes the course. Here he works 8 hours, as when he joined the freshmen in the "blue-print" room.

His last year, and not infrequently his third, often finds him, if he is anyway bright at all, doing some designing and equally complicated work.

Outside Work and Study

During these four years the young student is requested to study algebra, geometry, trigonometry, projection, use of the slide rule, stresses and strains of material, and to draw and trace 50 sheets of electrical apparatus, etc., from sketches furnished him. All this studying and drawing is done outside of working hours. Classes recite twice a week to the faculty, which consists of two instructors and a few others who examine drawings, tracings, etc.

The student's pay for the first six months is $3.41 per week. It is increased for the next six months, provided he has kept up with the studies required of him, to $4.32 per week. The same provision as to the studies and drawings applies to the remainder of the time spent on the course. The student *must* keep up with the schedule. At the end of his last year he is drawing something in the neighborhood of $7.50 per week.

When He Finishes

If—and it is a word of considerable size on a course like this—if he has completed the prescribed studies, completed his drawings, passed all exams and finals, has good deportment, is a hard worker, he is presented with $100 and a real draftsman's job. Needless to say that if the young man fulfils the above requirements, he is a highly polished article indeed.

At present there are about 150 taking the course, which is called the "E. D. S.," or Edison Drafting School, among themselves and friends. They come from all the States: one from Texas, one from Ohio, four or five from Nova Scotia, while Schenectady has only about four or five young men there.

Simple Oil Tests

By Geo. Schuelein

Having read so many articles in your columns about machines and their design, I want to contribute some hints on oil, to keep the parts in good running condition. A small manufacturer cannot employ a chemist to test the different oils he receives from the oil manufacturer, and he may lose dollars without knowing it.

There are a few simple tests which can be made by any man who uses oil. Before going into details, I want to call attention to the different kinds of oils, which are; plant oil, mineral oil, animal oil. The plant oils, as linseed oil or rape-seed oil, are resinous and rancid.

The mineral oil is manufactured from petroleum, which was probably formed by the remains of animals. The oil should be tested for body, gum, resin and acid.

To test the body, take a strip of glass 3 feet long and 2 or 3 inches wide; fasten a scale to it (any old ruler will do), and bring it to an inclined position. From perhaps two different sorts of oil pour a drop on the highest point of this strip; oil No. 1 may run 18 inches in an hour and oil No. 2 perhaps 2 feet, which shows you that the latter has less body.

In order to make a comparison with your next lot make a note of this, and you can come nearer telling what you get for your money.

To test the oil for acid, which it should not contain at all, take a medicine glass, put in warm water, some oil and litmus fluid. If the oil turns red and especially the litmus fluid, then it is allied with acid; but if the litmus remains blue, the oil is a good one, and therefore free from acid.

To make the third or gum test, let the oil used in first test stand an hour and then rub off; if easily removed the oil is practically free from any gum; but if it feels sticky the oil is mixed with plant oil or even with gum oil, which is extremely cheap.

An Apprentice School on a Small Scale

By J. B. Stanwood

The Houston, Stanwood & Gamble Company, manufacturers of engines and boilers, of Cincinnati, are operating, and have been for two years, an apprentice school which possesses some interesting features in that it represents the application to a moderate size industry of the day-school problem which is in vogue at the General Electric Company, at Lynn, Massachusetts.

The apprentice, 14 to 16 years of age, who usually applies for work to the machine shops of Cincinnati has but very little education. On the average it is doubtful if the amount of schooling this class receives is much more than that obtained by a child 10 or 11 years old; that is to say, the boy can read and write, and probably solve such problems in arithmetic as include only the simplest sums in fractions. He is not a high-school graduate.

The Studies are Practical

It would be folly to start such young men off in the strength of materials or to give them instruction in steam engineering or applied electricity. A school such as is here in operation undertakes to train the boys, first, in arithmetic, elementary algebra and applied geometry; second, in English, which includes reading, writing and spelling, and English composition; third, in mechanical drawing; all with practical and concrete examples and applications taken from their shop experience.

Each of the fifteen pupils who now attend this school gives six hours a week out of the shop's time to the class work. These class exercises are held on Monday, Wednesday, and Friday afternoons in two sections of two-hour intervals each; and the apprentice is under pay when working in school just as if he were at work in the shop.

No attempt is made to give special instruction in machine work; but as the only apprentices who are permitted to attend this school are under contract, and as that contract agrees to give them a specified time on lathe, planer and erecting floor, it is felt that they receive a reasonable amount of all-around shop training.

Is Optional with the Boy

It is not compulsory upon any apprentice of this company to take this course of schooling, but all are urged to do so. There have been one or two cases where young men have chosen to stay out, and they have at the same time developed into fairly good mechanics.

As to results: It is claimed that such a school as this increases the general intelligence and mental capacity of the apprentices; it also puts the management in closer touch with them; and it has been found that most of them have developed or are developing into higher-grade men than those who do not have the same opportunity. It is also believed that the six hours spent in the school does not seriously affect the output of the younger apprentices, who have not become accustomed to shop habits, for whom nine or ten hours' steady application a day is frequently a very heavy strain, so much so that in many instances their efficiency is often impaired; a two hours' "let up" three times a week is often an invigorator.

One noticeable feature of this school is the good will generated in the minds of these young men toward the management of the company.

Lack of Practical Education Prevents Progress

It has been found that forceful and earnest young men entering shops as apprentices finally rise to positions of considerable responsibility, only then to find that the unfortunate lack of a reasonably fair education is the only thing that restrains or prevents further progress. Such a school as here decribed obviates in a part this difficulty.

Securing the Teacher

One important feature of such a school is to secure a teacher skilful enough to instruct boys of varying capacities, and who shall have such knowledge of shop conditions and shop practice as to make the work of the school relate to and bear upon the work in the shop. This Cincinnati school has been able to secure for this purpose the services of a night-school teacher whose afternoons are unemployed, and it is hoped that other shops may be induced to take this matter up. If a number of shops would agree to operate such schools on their own premises and would combine to employ a first-class teacher all the time, it would be possible for such a teacher to handle probably four shops, giving twelve hours a week to each shop. This would reduce the expense to the shop and at the same time insure a competent man for the work. A group of shops with a group of teachers working in harmony with each other and with the shops would develop in a large manufacturing community a powerful influence for improving the quality of the men.

It will be a public calamity, states *Concrete*, if, in the general application of reinforced concrete for the construction of fire-resisting warehouses, cement and aggregates unsuitable for the purpose are used, or insufficient thickness of concrete for the protection of all steel work provided. Buildings erected on such lines will collapse when subjected to fire, and seriously discredit all reinforced concrete structures.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

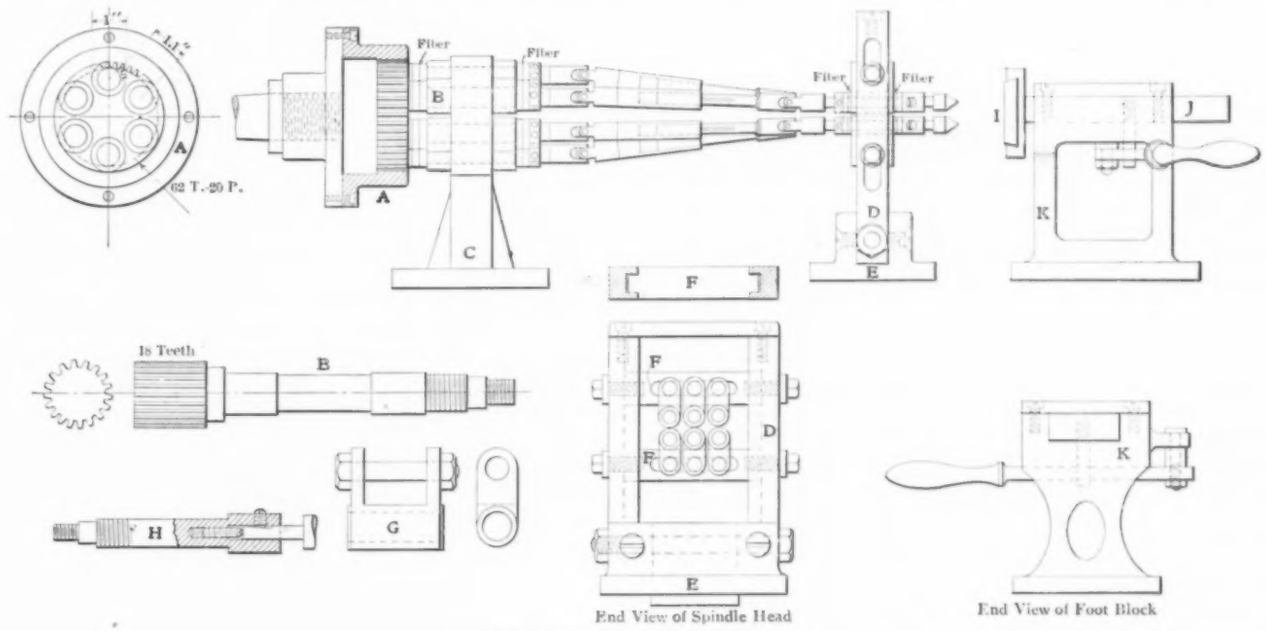
WE PAY FOR USEFUL IDEAS

Multiple-spindle Countersinking Rig

The drawing shows a six-spindle drilling or countersinking machine which I designed to countersink stamped and machine-made brass hinges. The spindles are adjustable from 11/16 to 1⅛ inch centers horizontally, and from 11/16 centers to 1½ inches vertically each way from central. Of course considerable more adjustment could be obtained by increasing the size of the front bearing bracket accordingly. There is nothing intricate about the apparatus. The only point calling for special care is the location of the joints are 9/16 inch diameter at the driving head, and ½ inch at the other end. The frame *D* and *E* is made up in the manner shown in the sketch. *E* is slotted through for uprights *D* and a packing piece put between the two, secured by four screws and a long bolt. Parts *D* are milled as shown in the cross-section, to allow the blocks *F* to slide up or down. For the sake of clearness the front bearings are not shown held in place on the frame with the securing bolts. The detail at *G* drawn to larger scale gives a better idea of the construction. The blocks are hard gun-metal castings bored 7/16 inch diameter for the spindles *H*. The lugs on *G* fit nicely over the blocks shown is placed on the sliding block in *K* and adjusted so that it is just about high enough to allow the countersinks to pull the hinges into position. There is no need of holding the work, as the twisting action is equalized. I find it quicker to drill the holes in the press and countersink afterward.

W. REYNOLDS.

Birmingham, England.



MULTIPLE-SPINDLE COUNTERSINKING RIG

holes in the rear bracket for the pinion spindles. The cone pulley head (not shown), with the gray-iron castings, is fitted on to the bed of an old turret lathe.

A is an internal gear fitted to a face plate which is threaded to fit the spindle nose. It is cut 20 pitch, 62 teeth. The pinion spindles *B* have 18 teeth. The pitch diameter of the gear $A = 3.1$ inches; the pinions are 0.9 inch on the pitch line, the full diameter being 1 inch. The distance between centers of the pinions is 1.1 inches, which leaves ample clearance for the revolving spindles. Through the bracket *C* are bored six holes ⅞ inch diameter, and hard gun-metal bushes are pressed in, which are bored 9/16 inch or the size of the spindles. The universal *F* which are slotted for adjustment, the bolts securing the parts firmly together. The method of adjusting the countersinks will be understood from the general drawing.

The block *I* is hardened steel. I found that the best stop scheme I could use was to round slightly the ends of the countersinks and feed up till they touched this hard block. One set of countersinks is needed for each different size. The only alteration I have made from the sketch is to increase the length of the handle of the back slide *J*. Oil holes are placed in convenient positions. The machine runs 1200 revolutions per minute, and is a time saver for anyone who has use for this class of tool. A guide which is not

Jig for Drilling Steam-pump Glands

I can fully agree with Syd. P. that criticisms make good men, and in view of his remarks in reference to the jig shown at page 384, I am again led to refer to it with a few remarks relative to the clamping screw shown. These are applicable not only to the jig referred to, but equally so to jigs and fixtures in general. If Syd. P. will again refer to page 384, he will note that the screw shown is a cap screw with a square head and a collar at the bottom of the head. Years of experience have demonstrated that the most desirable wrench for use in connection with jig and fixture work, where wrenches are required, is a socket wrench with a tee handle, made of a steel casting with the socket end cored to fit freely the screw head, and of such shape as will have the least tendency for the wrench to slip over the corners of the screw head

when pressure is applied. Since a square form of head offers a great deal better gripping surface than the six sides of a hexagon, it is evident that a square head, as shown, is preferable to a hexagon nut, while the free fit of the screw in the locating stud renders the removal of the stub end easy if twisted off, without damage to the locating stud.

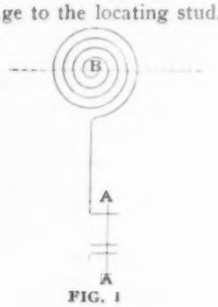


FIG. 1

This form of screw being adopted as a standard jig screw and carried in stock in a range of sizes renders repairs possible with little expense or delay.

This screw is simply a means to an end, and may, or may not be, mechanical, but will Syd. P. kindly state for the common benefit of the readers of the AMERICAN MACHINIST, myself included, his reasons for preferring a screw with a tight fit and a loose hexagon nut? I shall later, again refer to this screw as used in combination with various other standard jig parts which are applicable to a variety of jig work, requiring little or no machine work in their construction, and which are and have been in daily use for some years. It is true that the split washer is easily lost, and that the jig requires turning over to remove and replace the piece, but as to whether more or less time would be lost in turning over the jig, or in mounting Syd. P.'s first jig on the necessary pieces of waste material might be a debatable point.

After an extended experience in the use, design and construction of jigs and fixtures for manufacturing purposes, I have yet to recall an instance where a jig with thin webs has ever been broken in handling, although I have had a few instances where the feet have been broken off due to defects in the casting. In designing, it is important that the designer should pay particular attention to the distribution of the metal, arranging the webs in such a manner as to guard against undue distortion from the pressure of the cutting tools, and clamping devices, and secure the maximum rigidity with the minimum of weight. H. D. PENNEY

Winding Scroll Springs

This rig was made a few years ago for winding scroll springs that were used on a shoe-sewing machine, for taking up the slack thread on the return or up stroke of the needle.

The spring was made as shown in Fig. 1, and the method of winding was on a pointed center fitted to the speed lathe. The angle of the center was about 50 degrees with a spiral V groove cut on it with just enough lead to let the wire lie easily and with a slot cut across the point to hold the wire, as in Fig. 2.

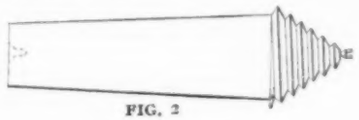


FIG. 2

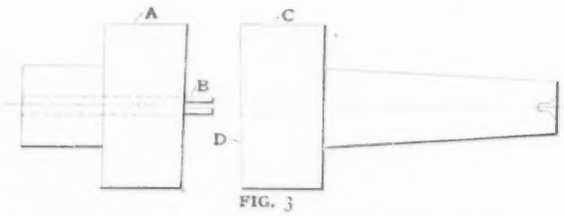


FIG. 3

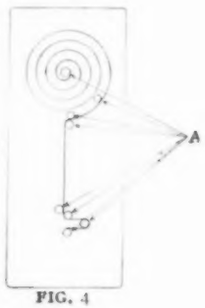


FIG. 4

WINDING SCROLL SPRINGS

Using this center for winding, the spring was "dished," and it was necessary to spend considerable time in straightening it. As I had about a thousand to make I wanted an easier way of doing them and having them straight.

So I turned up the pieces *A* and *C*, Fig. 3, out of machine steel, *A* to fit the chuck and with a hole through the center to remove the pin *B* as it was found necessary. The pin *B* was of drill rod hardened and drawn to a spring temper; but after breaking several they were left soft and lasted longer. The piece *C* was of machine steel, and fitted to the tailstock spindle with the face *D* concaved for about ½ inch from the center line. Both the pieces *A* and *C* were case-hardened.

The end of the pin *B* was slotted to take the end of the wire, and hold it while winding.

This left the finished spring as at *B*, Fig. 2, which end was afterward cut out to put a screw through to fasten the spring in position.

The rig was used as follows: The end of the wire was placed in the slot of the round pin *B*, Fig. 3, the part *C* in the tailstock to bind the wire a little and the belt pulled by hand to rotate the part *A* the required number of times, which was noted after a few trials; the required pitch being secured by noting the tension of the wire in binding.

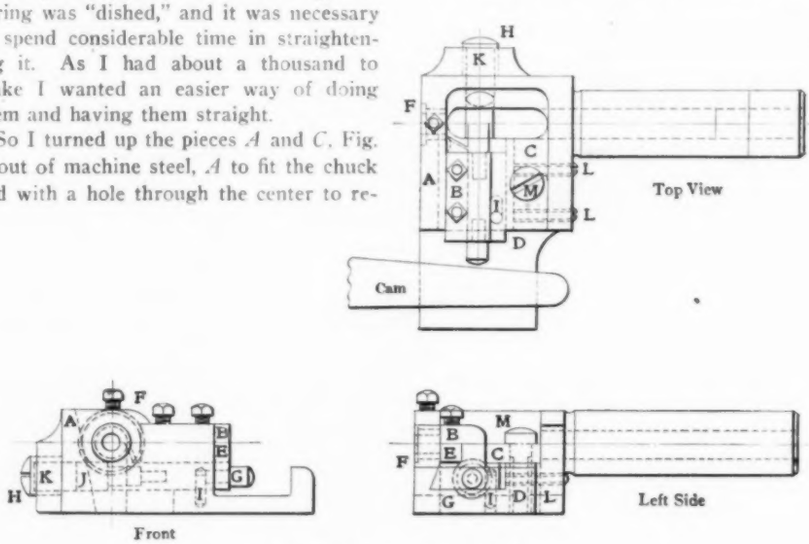
The right-angle bends and hook were had by using the cast-iron plate, Fig. 4, the spring being placed in position, and then passed around small pins *A*. The hook was then bent up and the spring so completed. W. E. M.

An Improvement in Turning Taper Pins

Referring to page 402 and the article "Box Tools for Small Taper Pins and Handles," by Tapers, there is no doubt that such a tool will produce a taper pin, but I do not see how it can be really accurate. Every detail seems to have had attention and everything seems to have been done except the one fundamental and essential thing necessary for the production of accurate taper pins.

He pushes his cutter slide forward with a cam or slide. The force to do this is applied at stud *G*. Now this force will tend to move not only the slide in which the tool is held but the box tool as well, and will actually do so within certain limits. The cut made by such a contrivance must consist of a series of steps more or less regular.

To produce really good taper pins with



BOX TOOLS FOR TAPER PINS

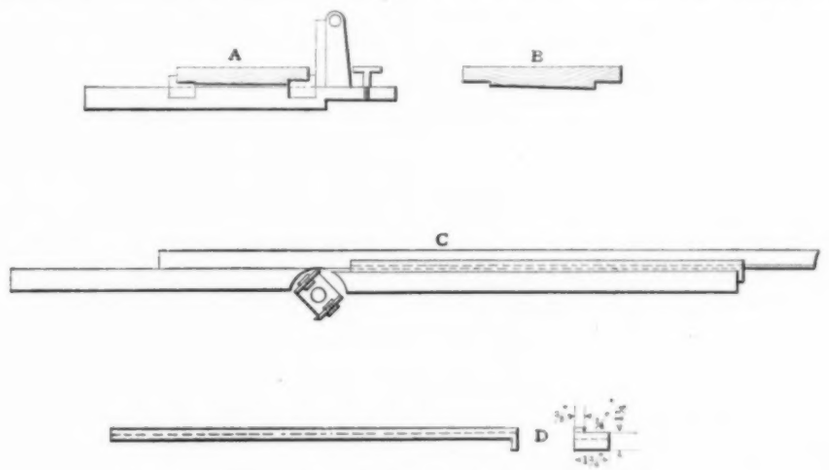
a box tool it is absolutely essential that a projection from the body of the box tool be carried around behind the cam so that the action of the cam, as the box tool is forced upon it, is that of separating two parts of the mechanism by forcing a wedge between them. In this way any force exerted against the slide forward is resisted by an equal force on the opposite side of the cam by the projection from the box tool itself, keeping the work in balance and insuring a regular advance of the cutting tool and consequently an accurate taper pin.

HARVEY E. BROWN.

Straightening Pattern Stock on Buzz Planer

Quite a number of pattern shops having no surfacing machine but a buzz planer are often required to work stock "out of wind." In a great many instances this is done by surfacing one side, then gaging the other side by hand. It is then run over the buzz planer until the stock is sized down to very near the gage lines, when a finish cut is taken. I have often noted that this takes quite a while, especially with beginners or those not as skilful as they might be. The accompanying sketches show how the stock can be straightened with very little trouble in pieces from 2 feet to 16 feet long.

Get out two parallel strips as at *D*, about ⅜ by 1¾, and fit them up on the planer platen. The size of the planer will determine the length of these strips.



STRAIGHTENING PATTERN STOCK ON A BUZZ PLANER

Place these strips on the planer platen and secure with a lip on end as shown.

Now take your stock which is dressed on one side and edge, run this over the rip saw, planed face against saw guide, and parallel the two edges, allowing about 1/16 inch for final dressing, as at *B*. Place this on your strips on the planer platen (see *A*), run down the table until the cut removes all superfluous stock under the parallel cut, as at *C*. After this is done your stock will be parallel and a finish cut will give you a board or plank perfectly straight. In working different widths of stock you will of course have to change the position of the outside strip.

If much work of this kind is done it will pay to have these strips made of cast iron and plane them to suitable sizes. Put lugs on them and drill corresponding holes in the planer platen so they can be readily shifted from one position to another.

There is also a distinct advantage to work lumber in this way where the quality of pattern work is considered, because in dressing pattern lumber on a surfacer the grain is compressed to such an extent that no matter how much hand dressing you do, the grain is bound to come out after shellacking or when the pattern goes in the sand.

The sketches make all the operations clear.

A SUBSCRIBER.

A Drill Jig for Rapid Work

The sketch is of a drill jig, which has proved to be a very handy and efficient tool; the scheme, although not an original idea by any means, is very simple.

On the small piece shown in Fig. 1 it is required that the hole drilled by means of the jig shown in Fig. 2, be a certain distance from the shoulder on the piece, and that the hole be drilled in the center and straight; as there is an enormous quantity of these small pieces to turn out, this jig was devised. There may be a number of other tools that would insure as good and accurate a job as this jig, but for rapidity I know of none that can compare with it.

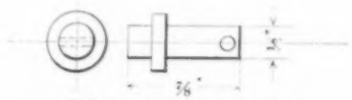


FIG. 1 The Work to be Drilled

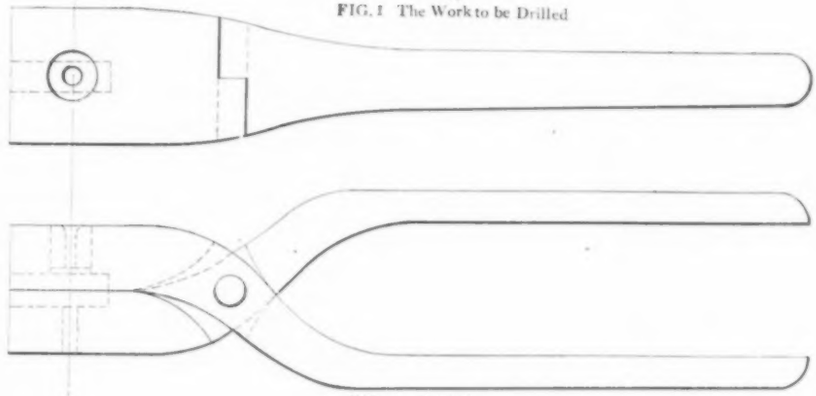
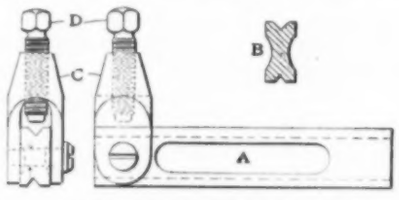


FIG. 2 Drill Jig

M. J. H.

A Drill Holder for the Lathe

This holder for small drills was designed to be used in the tool post of the lathe. Its convenience and use will be apparent to anyone who has had to drill small work held in the lathe chuck. Among its good points is the ease with which a drill may be removed, ground and replaced in identically the same position.



A DRILL HOLDER FOR THE LATHE

As will be seen by reference to the illustration, the shank *A* has two grooves, shown in the section at *B*, one larger than the other, to accommodate varying sizes of drills. The clamp *C*, carrying the clamping screw *D*, can be swung around and used with either groove.

S. W. MILLS.

Boring and Facing a Hydraulic Press with Portable Tools

It is not a difficult job to machine a large piece of work when you have machines large enough to take the piece and ample crane capacity to handle it. On the other hand it has sometimes been found more economical to have a portable machine than to move the casting to a large machine that could handle it. The use of

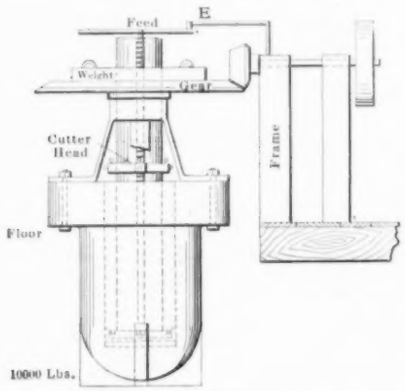


FIG. 1. BORING THE CYLINDER

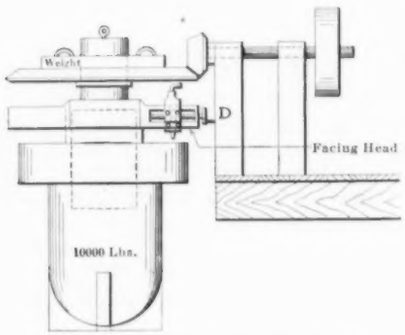


FIG. 2. FACING HEAD IN PLACE

compressed air and electricity as a means of transmitting power makes many more portable tools possible than formerly. This is the way we machine a large hydraulic cylinder.

Fig. 1 shows the cylinder let down in a pit about even with the floor. It is then leveled up and a spider placed in the bottom of the cylinder with a center projecting upward in the same shape as a lathe center. The spider is held in the usual way by set screws, and we put the boring bar in as shown. This is supported by the four-legged spider that is made to fit the boring bar. The cylinder is not bored the whole length or the spider could not be used.

The cutter head carries four cutters, as shown in Fig. 1. The boring bar is fed by a star-feed at the top as shown and Fig. 2 shows a facing head on the bar which is fed by the star wheel at *D*.

On the top plate we have four bosses, or collars as shown at *E* Fig. 3, and these bosses are turned both inside and out. The boring attachment fits over the outside of the boss and is held in place by set-screws as shown. This is for boring the four holes for guide rods and is driven by a worm-wheel, the worm being

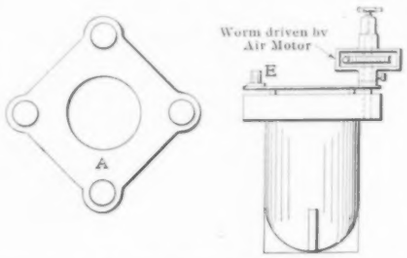


FIG. 3. LOCATING AND BORING HOLES FOR GUIDE RODS

driven by an air motor. The bar is fed by the feed screw, by hand. The templet being clamped to the top of the cylinder brings all the holes correct, and the boring rig is moved from one hole to the other, the bosses are also faced off on the under side by the use of a small facing head clamped on the bar that bores the hole, and it is fed by hand as the boss beneath only has a small surface to be faced. In this operation the tools are many times lighter than the cylinder and they work rapidly and accurately. I hope this simple arrangement may assist some of our readers. C. R. McGAHEY.

Graduations for Micrometers and Scales

Fig. 1 shows a micrometer caliper, which was made from sketches furnished by me Nov. 27, 1900, although it appeared later that the late Mr. Borton, then with the Brown & Sharpe Manufacturing Company, had some similar idea previously, as applied to a scale.

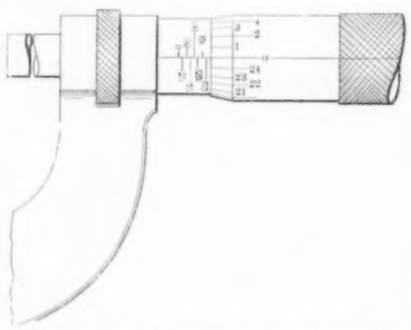


FIG. 1. DIRECT READING MICROMETER

The idea is to make the graduations direct reading, to avoid the liability to error in reading the ordinary divisions. I think the sketch will show clearly how this result is obtained by staggering the figures, which otherwise it would be impossible to stamp in a space of 0.025 inch.

As a matter of fact, in my original sketch I arranged the "staggers" so that there was 0.100 inch for each number, which I think is better than in the scheme shown. I also called attention then to this method of marking indications on all scales, or dials, whereby minute graduations can be easily and accurately read, in connection with a movable slide or index finger.

I need hardly enlarge on the difficulty of reading sixty-fourths on an ordinary scale. With the staggered arrangement, they can be made direct reading, as shown in Fig. 2. I do not know that any of these have ever been made.

I have been trying unsuccessfully to get a micrometer made with a screw 32 threads to the inch, and 32 divisions on the thimble, thereby giving all usual divisions of an inch by halves, from ½ inch to 1/1024inch, or one sixteenth of 1/64 inch, which is near enough to 0.001 inch for most work (only one-fourth of 1 per cent.

FIG. 2. PROPOSED GRADUATION FOR MACHINISTS' SCALE

out), and is readily understood by mechanics who often "split sixtyfourths."

ROBERT J. HEARNE.

Germans Not in Favor of a Metric Twist-drill Shank Taper

The German manufacturers of twist drills, meeting in Hannover, declare that the proposed introduction into Germany of a metric taper, instead of being an advantage, would be a disadvantage. They combat the assertions of those in favor of the metric taper as follows:

It is true that the Morse tapers Nos. 4, 8 and 6 show some difference of taper from Nos. 1, 2, and 3; also that the dimensions, in English inches, give no even equivalents in millimeters. This, however, makes no difference; because nowadays such tapers are not made according to measure, but according to gages ground exactly to size, so that it makes no difference whether or not the measurements are in even millimeters or fractions thereof.

The statement that the Morse taper has undergone changes in the course of time is not correct. It is called forth by the fact that at one time tests of twist-drill shank tapers of various forms showed differences, such drills being made by hundreds of small firms as a side line, who took no special care to make their product exact. Today, however, twist-drill man-

ufacture has become a specialty; they are made in great quantities, and all dimensions are exact to the standards. [Here follows in the report a short table giving in millimeters the exact dimensions of all the Morse tapers.]

There are further commercial reasons for keeping the Morse taper. Twist drills are a staple commercial article, the price, dimensions and quality of which cannot be established alone by German makers. At present there are necessary a great number of special machines to make them; if it were required to bring out a metric taper it would be necessary to put in new special machinery specially therefor. Furthermore, to double the amount of stock necessary to be kept by dealers would be a heavy burden.

The introduction of the new metric taper would call for making 1000 new articles which would have to be kept in stock together with the 3000 old ones. The expense of such increased stock would have to be borne not only by the manufacturers, but also by the dealers.

ROBERT GRIMSHAW.

[No better argument against the adoption of the metric system was ever made than this which comes from Germany. It relates to a single article of manufacture only, but its application is universal. No advantage would follow the change, and its cost is prohibitive. That is the point to which all arguments lead.—ED.]

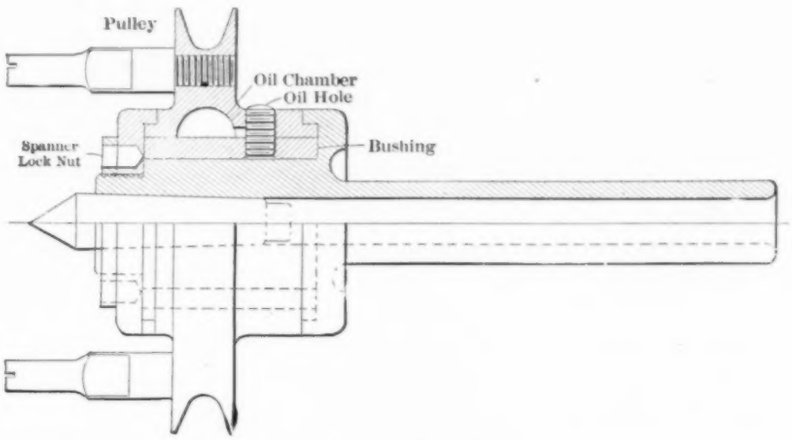
An Emergency Grinding Arbor

A letter on page 541, "A Makeshift Drive Fit," called to my mind a method resorted to by a grinder man in making a grinding arbor for an odd-sized hole. He had an arbor in stock a little under size, which he nurled and then ground down to the required size, removing the stock that the nurl had crowded up. This answered the purpose first rate, and did not take much longer than turning off a chip would have, if the arbor found had been too large. It was quicker than getting a piece of stock, centering it and turning it for a new arbor.

TOOL ROOM.

A Grinder Head

The grinder head here illustrated was designed to be dust-proof, and is giving good satisfaction. The body and lock nut are recessed to receive the bushing and pulley. Holes are drilled on a tangent through the bronze bushing in such a way that the oil is forced out of the oil chamber in the pulley to the journal bearing. The body of the head is stationary, giving the dead center.



A GRINDER HEAD

The head is simple, compact, self-oiling, dust-proof and has a large bearing surface. The body and retaining collar are of machinery steel, lock nut and drivers of tool steel, pulley of cast iron and the bushing of hard bronze.

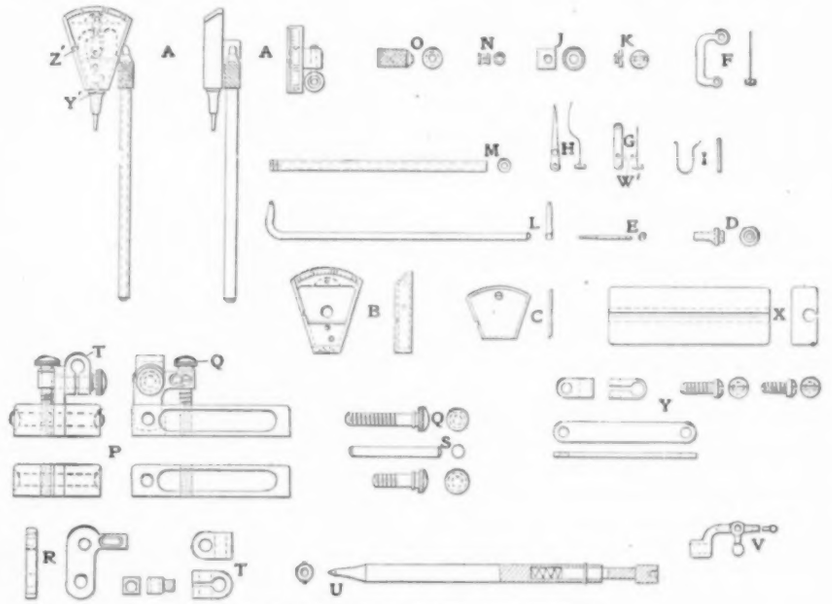
C. A. KELLEY.

An Indicating Gage and Attachments

This gage, which was developed for use on very accurate work, is shown assembled at *A*. The box containing the mechanism and having the graduated scale is made from a solid piece of machinery steel and is shown at *B*. A dovetailed groove is milled in the side to receive the cover plate, which is held in position with a small screw *z'* at the side.

This removable section of the cover does not form the entire top of the box, however. The rest of the cover is formed by another small plate dovetailed and soldered into place after the opening beneath is properly dug out.

The lower end of the box is drilled and tapped to fit the barrel *D*. A small screw *y'* goes through the shoulder of the barrel, acts as a stop and prevents the pin *E* from dropping out. This pin is hardened and lapped to a true fit in the barrel. One end is rounded while the other end is beveled to a knife edge, so as to have as little bearing surface as possible on the side of the first lever *F*. This lever is made of sheet steel 0.012 thick. One end has a 1/8-inch hole and is hardened. Into the other end is soldered a 1/16-inch hardened bushing having a 1/32-inch hole. Similar bushings are in levers *G* and *H*. This 1/32-inch hole forms a bearing for the 1/16-inch 60-degree pivot screws. The second lever *G* is made in a similar way, except that a sharp-pointed pin is riveted on at *w'*. This is hardened and stoned to a fine edge and slides in the hole of lever *H*. Of course it is very essential when laying out the holes for two pivot screws and the sliding holes that they are all on the center line. A very fine hair spring *I* is pinned to one side of the box and bears against the



AN INDICATING GAGE AND ATTACHMENTS

hardened point on lever *G* and lies between levers *G* and *H*. This makes the indicator very sensitive when in use.

The gage has a double joint, so it can be placed in any position. The holder *J* turns on a shoulder screw *K*. In its taper hole fits the bent rod *L* held by a washer and a nut. The length or hight of the gage is increased by the tube *M*, fitting over the rod *L*. This is threaded on one end and bears against a spring collar *N*. Over the collar and screwed to the tube is the nurled nut *O*. Tightening the nut clamps the tube and rod. It is very handy to have two or three tubes of different lengths to accommodate a range of hights.

To obtain a large range of adjustment when setting a special surface block, holder *P* was designed. This has a movement in the screw *Q* of about ½ inch. The bottom of the holder is hardened and lapped. The slot in the front is a tight fit for the arm *R*. This arm rocks on the pin *S*, is connected to the screw *Q* and carries the split clamp *T*. This clamp holds the gage in any desired position.

The gage as made had a ratio of movement between the pin *E* and indicating pointer *H* of 1 to 75. It is thus available for very accurate work. When used in holder *P* it is well adapted for lathe and bench operations. For indicating center-punch marks in the lathe, pin *U* is used. This has a 60-degree point which enters the punch mark. The other end is held on the tailstock center.

By bringing the pin of the indicator in contact with the pin near the work, the center-punch mark can easily be tested and trued up. The 60-degree point is always under a slight pressure against the work from the small spiral spring shown inside the pin. The indicator is also useful in truing up a hole, or projections and buttons on jigs and fixtures, when on the face plate.

When bolts or clamps are in the way, attachment *V* often overcomes the difficulty. This slips over the barrel of the gage. As shown in the cut, the ball point of the attachment is removable. Thus various lengths and shapes of points can be used.

For use in comparing the lead of a lathe screw with a master-screw plug, insert a sharp point in place of the ball end. Place the cast-iron holder *X* with the gage in the tool post, and bring the sharp point in contact with one side of the thread of the master plug, so that the gage will indicate some particular point of the graduation.

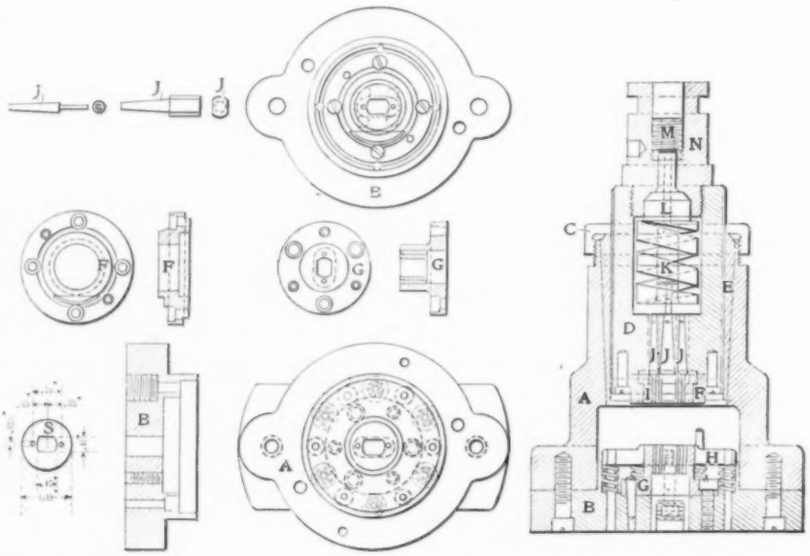
Attachment *Y* is convenient on the drill press. The long thin bar is fastened at one end to the machine in some convenient place. The other carries the clamp shown above it in the cut, and this clamp in turn holds the indicating gage. When not in use the gage can be swung back out of the way.

R. A. Almond.

A Sub-press Die

The accompanying illustration shows a type of sub-press die which was first used for blanking watch movements, but which has since been quite extensively used for clock, typewriter and other work requiring great accuracy.

But little explanation is required. The blank which the die produces is shown at *S*. The upper half of the casting, or cylinder *A*, is shouldered on to the base *B*, and is held by screws and dowels. The upper part is bored out tapering, and a heavy nut *C* is fitted at the top to take up the slack caused by wear. The plunger *D* has three semi-circular grooves spaced equidistant, which engage the babbitt *E* with which the casting is lined. The die *F* is screwed, and doweled to the plunger. *G* is the punch which is recessed into the base and held by screws and dowels. Both punch and die are pack hardened.



A SUB-PRESS DIE

The stripper *H* is made a close sliding fit on the punch, with a sufficient number of springs below to strip the stock. The amount of tension required is considerable if the stock is thick, and if there is much cutting surface. The stripper is ground flush with the punch.

The shedder *I* fits the die very closely and throws the blank back into the scrap. It also serves to keep the stock flat when struck.

The small punches *J J* are fitted into the plunger on a taper, are supported by the main punch and are carefully alined with their corresponding openings in the main die. The spring *K*, which backs up the shedder, needs to be quite heavy and should be bored and chased in the lathe. Adjustment of its tension is secured by the plug *L*, which is forced down by the screw *M*. The plunger is driven by the top cap *N*, the stop of which is engaged by the gate of the press.

Whether the plunger of a sub-press should be babbitted before the punch and die are fitted or afterward is a disputed point. Some consider it good practice to set the finished die and punch in the usual manner, level up the plunger carefully and pour in the babbitt, while others prefer to babbitt the plunger before the punch and die are made. The latter method is condemned by some on the grounds that if the punch "goes" a little in hardening, it is difficult to bring it in line again. This can be overcome by entering the punch in the die attached to the plunger, swinging the plunger in a steady rest and grinding to a fit the recess in the base. The method of babbitting the plunger first has one advantage, however, in that the sub-press can be set up and run a half day and the nut well set up before the punch and die are made. This is quite a valuable little "kink," for no matter how carefully a plunger is babbitted it will creep ever so little after it is used, and it is much better that this change should take place before the alining of the punch and die.

With either method the very best babbitt procurable should be used, and it is needless to add, do not have any moisture about the casting when the babbitt is being poured.

In punch and die work a good method which is rather out of the ordinary is to select a piece of stock for the punch long enough to finish ¼ inch longer than the required length. After machining the punch accurately cut 3/16 inch off the face and use this as a templet to work through the die. In this way a templet is secured without any extra work, and it is not necessary to shear either punch or die. In the die illustrated the center punch *J* was left ¼ inch long and the piece cut off was used in making the opening in *G*.

Roy Plaisted.

A Question in Designing a Press Frame

The following problem came to me recently in the design of a special machine, which involved as one of its parts a press to carry some 40,000 pounds pressure. It seemed convenient to make the frame of cast iron reinforced with two steel rods, as indicated in the accompanying figures. The problem seems to me to be quite as interesting as the one which Mr. Osborne started on cast-iron beams, and since there appears to be next to nothing of the sort in books, a discussion might be worth while.

The First Design

I fell back on my native common sense and drew what appears in Figs. 1 and 2, and then tried to confirm it by some sort of theory. One of the things I had picked up was the pointer given by Mr. Nickel at page 813, Vol. 29, Part 2, showing how to get the position of the neutral axis, etc., of a non-homogeneous section. The application as given was to a cast-iron beam, while mine is a steel and cast-iron beam; but it looked at first as if there might be something in it. I decided that I did not want to put the cast iron into tension at over 3000 pounds per square inch and rated the steel at 15,000 pounds, just to get an easily used ratio, 1:5, between them. Then I laid out a cross section as in Fig. 1, on the line $A\,B$ of Fig. 2.

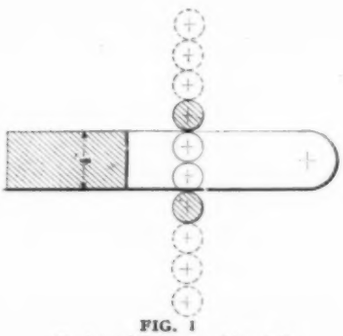


FIG. 1
Horizontal Section on Line A-B

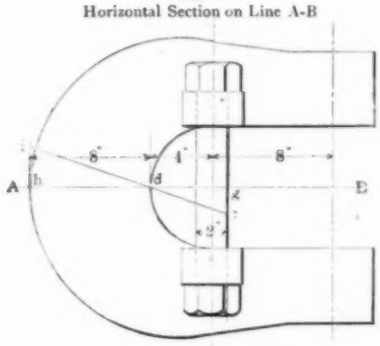


FIG. 2
The Frame as first Designed.

Analyzing the Design by Mr. Nickel's Method

I added to the cross section eight more 2-inch circles, thus substituting ten 2-inch bolts of cast iron for two of steel, which, with the ratio given, would be their equivalent. Then I found the center of gravity of this total cross section to be at d, Figs. 1 and 2, 7.96 inches from the left-hand edge of the section, or practically on the right-hand edge of the section. This appeared to throw practically all the tension on my ten cast-iron bolts, which the two steel ones were ample to replace, and all the compression on the cast iron, which was more than strong enough to carry it. Drawing a line on Fig. 1 through d, such that $g\,e$ represents a pressure of 3000 pounds per square inch, then $f\,h$ represents the greatest stress on the cast iron, in this case 4800 pounds, which is a long way within the safe limit.

Figuring the press through on this basis, I used the familiar formula

$$M = \frac{p\,I}{e},$$

where M is the moment of external forces (in this case equal to P, the punching pressure, times 12 inches, the distance from the punch back to the center of gravity of the cross section at d); p, the maximum fiber stress in tension, is 3000 pounds; e, the greatest distance to a fiber in tension, is 5 inches (we know that the compression side is strong enough), and I is the moment of inertia of the entire cross section, including the ten cast-iron bolts substituted for the two steel ones, in this case 1195.5. $P = 59{,}775$.

The total area of cross section of actual metal is 4x8 inches = 32 square inches, plus the cross section of the two steel bars, 6.28 square inches. This has to withstand the total pressure on the machine in tension as well as this bending moment. This gives a tension of about 1560 pounds per square inch, which must be added to the tension already found, and subtracted from the compression. This gives 16,560 pounds per square inch on the steel bars. If for the sake of comparison we reduce this pressure back to 15,000, it reduces P to about 54,000, which is ample.

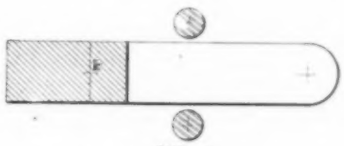


FIG. 3
Horizontal Section on Line A-B

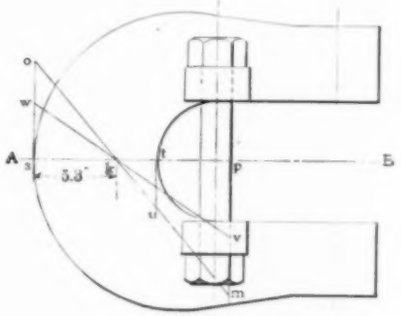


FIG. 4
Analysis upon the Assumption of an All-Steel Frame.

An Analysis Upon the Assumption of a Steel Frame

But even after having found that my guesswork was amply strong, I was curious to know if the thing was not really stronger still. No part of the 8x4-inch section was apparently in tension, and the compression in it was well within what would be safe. Cast iron in compression will certainly stand as much as steel in tension.

I went through the figures again, this time treating the section as if all of one material, steel, with only the two 2-inch bars originally used. The center of gravity came at k, Figs. 3 and 4, 5.3 inches from the left-hand side of the section. Here I was, then, with a prospect of the cast iron being divided, part in tension and part in compression; but I went on and drew a line $m\,o$, making $p\,m$ represent 15,000 pounds per square inch. $O\,S$ represented then 10,300 pounds per square inch more than before, but still well below the allowable stress. At $t\,u$ the stress (tension) represented scales 5260 pounds, or more than the allowable tension for cast iron. More than that, I still had the 1560 pounds per square inch tension over the whole area to add to this tension.

Now which is right, or are both wrong? According to the first way of figuring no part of the cast iron was in tension and the whole thing was safe for practically 54,000 pounds. By the second method I must draw a new line $v\,w$ through k, cut-

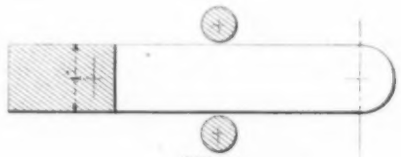


FIG. 5
Horizontal Section of the Frame as Redesigned.

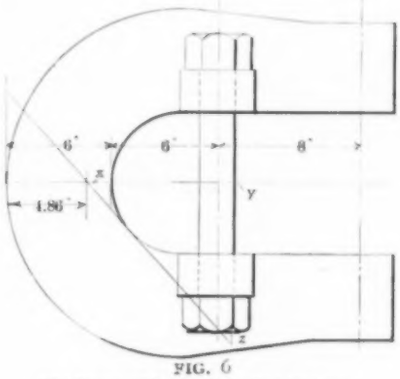


FIG. 6
The Frame with some of the Cast Iron cut out in order to reduce the Tensile Stress on it.

ting off 3000 — 1560 pounds on $t\ u$ and making $p\ v$ equal to 4100, which is the p of our equation. Figuring on this basis, P, the allowable pressure on the punch, is 18,600 pounds, which is too low.

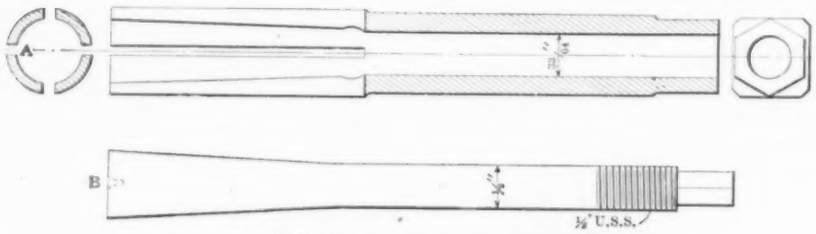
Cutting Out Some Metal to Strengthen the Frame

Now it occurred to me that I might strengthen this section by the last method of figuring, if I cut out a little cast iron. Figs. 5 and 6 show the same frame with 2 inches cut out of the throat. The center of gravity of this cross section, the material being homogeneous, is at x, 4.86 inches from the left-hand side. Drawing in our diagonal line, starting at 15,000 pounds at $y\ z$, we find that the tension on the cast iron at the throat is only 2100 pounds, to which we must add the tension in this case, which is a trifle less, or about 1500 pounds per square inch, making 3600 total. Reducing this to 3000 gives a compression at the left of about 7500 pounds, and makes the allowable stress on the press about 46,000, which is also safe for my requirements.

Now which is the stronger, Figs. 1 and 2 or Figs. 5 and 6, and why? Please tell me. Con Wise.

A Putting-in Tool

The sketch shows a tool designed for putting in new seats in a valve for a hydraulic riveting machine, the body of which was bronze. The valve was bored out to 1⅜ inches and tapered 1/16 inch per inch. The seats were about 4½ inches down in the body, so, to get the new seats in, the wrench was made of tool steel, spring tempered and ground to size at the slotted end, the diameter of which was 1 inch, equal to the size of the holes in the new seats.



TOOL FOR PUTTING NEW SEATS IN A RIVETER VALVE

It has also been used for inserting many threaded bushings with larger-sized holes in them, by the use of a split collar on the end, designed to suit the case. Mac.

A Hurry-up Automobile Job

Not long since a man came to the shop, dragging an automobile of Italian make. Some of the bolts holding the cylinders to crank base came loose and broke the flange off, as shown at A, Fig. 1, and left it in six pieces, as at Fig. 2.

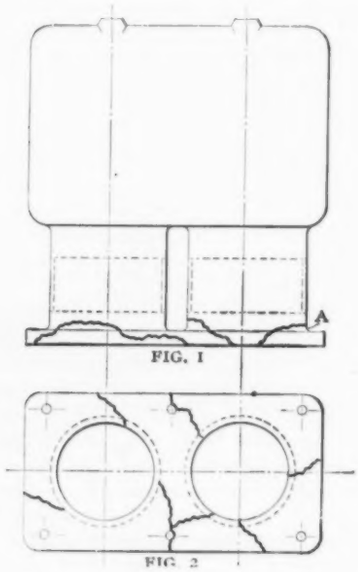


FIG. 1

FIG. 2

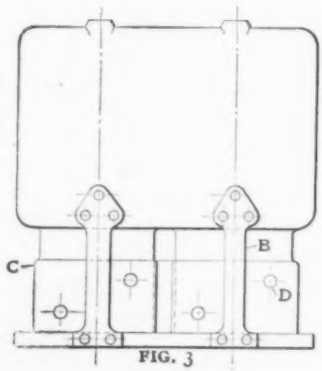


FIG. 3

REPAIRING CRACKED AUTOMOBILE CYLINDERS

It was impossible to get other cylinders as the firm were making a new type and the old patterns had been destroyed.

I shellacked the parts together, had the patternmaker make a templet of wood for drilling bolt holes, also a pattern for a new flange as shown at C, Fig. 3.

I then put the cylinders in the boring mill, faced and turned them as in dotted lines, Fig. 1. I planed the face of the new casting, put it in the mill, bored it, allowing 0.004 forcing fit, forced it in place, tied it with eight screws D, Fig. 3, and four straps, B, Fig. 3.

It is still in use. L. H. Haight.

Friction Drive for a Band Saw

In the pattern shop or in any woodworking shop where a band saw is used, the starting and stopping or in other words the shifting of the belt is a nuisance and is laborious, particularly when this is done several times each day.

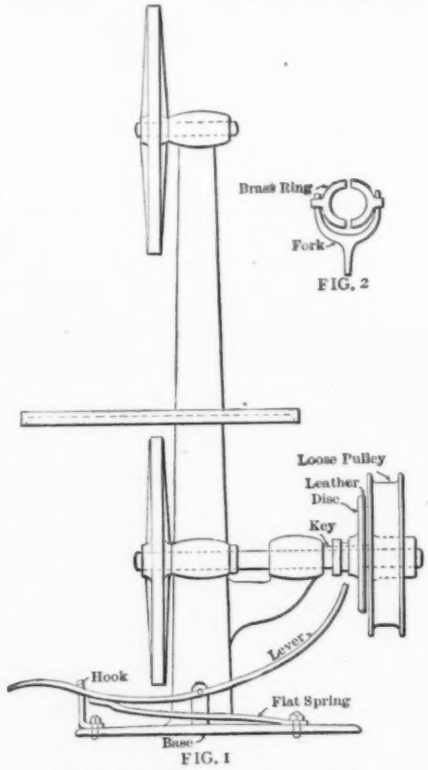


FIG. 1

FRICTION DRIVE FOR A BAND SAW

I send herewith a sketch showing a change I made on an old band saw for the sake of an experiment, which gave good results. I removed the tight and loose pulleys and in their place put a sliding friction disk and loose pulley. The disk was shifted by a lever under which was a flat spring, the spring being powerful enough to force the leather face disk into contact with the pulley, thus driving the saw. The disk was kept out of contact when not in use by a hook at the front of the machine; a downward pressure and side movement of the foot releases the lever and allows the spring to act at once.

Fig. 2 shows the yoke end of the lever fitting over the hub of the disk. I am sure this will interest band-saw manufacturers. Band Saw.

Tapping Water Mains under Pressure

There are few more striking examples of a large hollow mill working under peculiar circumstances than in the pipe-tapping machines used for making permanent or temporary connections with water mains while under pressure. This avoids inconvenience and delay, as well as loss of water, if the water has to be shut off when connections are made.

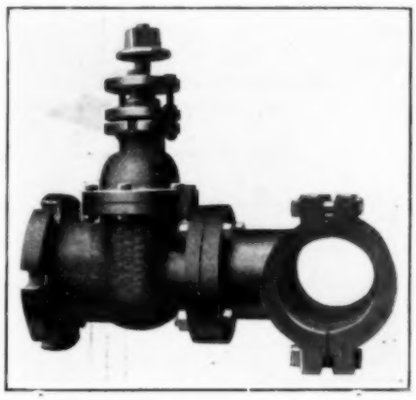


FIG. 1. CLAMP FOR CONNECTING TO WATER MAIN

The first step is to clamp the sleeve at the right of Fig 1 around the pipe to be tapped, and the ends are made tight in the usual way, with yarn and lead, though in large sizes a cement grout is being used successfully for the larger part of the joint, materially reducing the cost of lead needed. This fastens the sleeve permanently to the pipe.

To this is bolted the gate valve shown, with the outer flange slotted instead of with holes; but otherwise it is practically a regular gate valve. The tapping machine bolts to the slotted flange, making a tight joint with it, and the boring bar is packed to prevent all leakage around it.

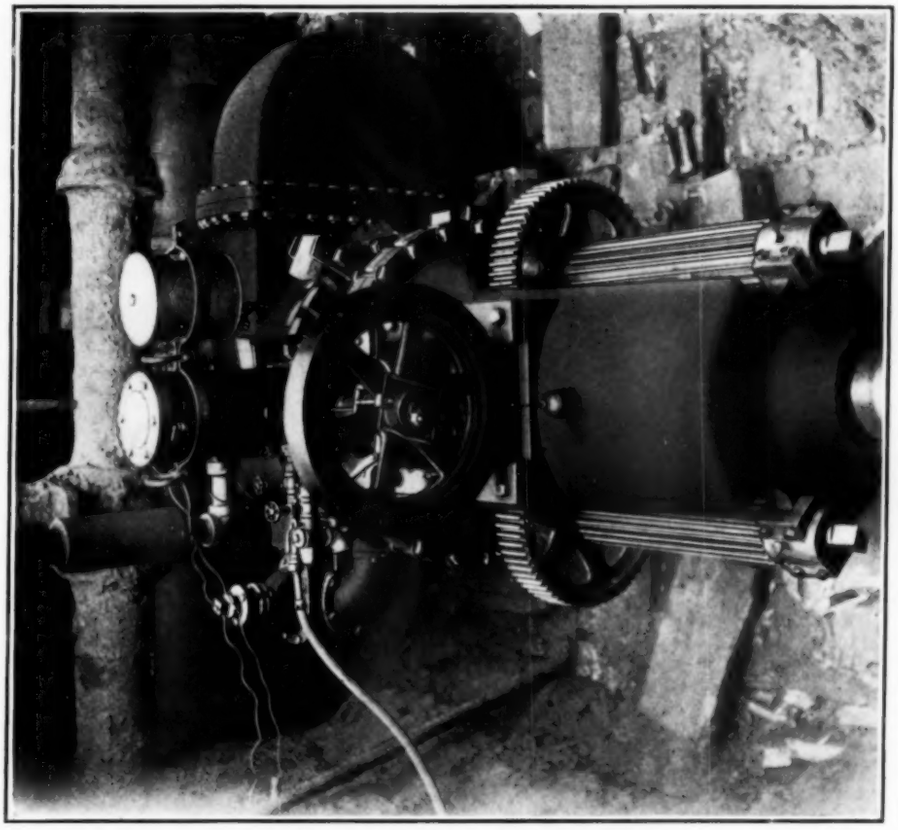


FIG. 2. WATER-MAIN TAPPING MACHINE AT WORK

The machine consists of a mechanism for driving the hollow mill, being operated by hand in the smaller machines, but having a gasolene engine mounted directly on the machine for the larger sizes. The boring bar is of course central with the machine and driven from the long pinions on each side to insure even and steady driving as it is fed into the work.

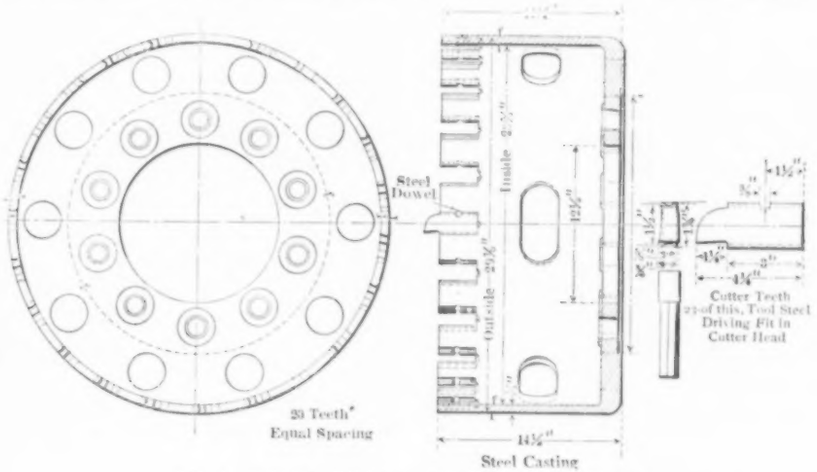


FIG. 3. HOLLOW MILL FOR WATER-PIPE MACHINES

A Machine At Work

Fig. 2 shows one of the larger machines in a trench, making a 30-inch connection with a 30-inch water main at Trenton, N. J.

A 1½-inch leading drill was followed by a 4-inch cutter to make room for the supporting bar of the 30-inch cutter. The large cutter took 59 minutes in addition to a half hour spent in getting the smaller holes through. The engine is rated at 6½ horse-power and used 2½ gallons of gasolene. The whole machine, including the engine, weighed 5500 pounds. The piece cut out is held on the bar so it cannot be drawn into the pipe.

The Hollow Boring Tool

The milling cutter is interesting, especially the sizes over 8 inches, which have inserted teeth as shown in Fig. 3. The body is a steel casting ⅛ inch less in diameter than the hole to be bored. The teeth are inserted in the dovetailed slots and pinned on the back side. The faces of the cutting teeth are spread 1/16 inch on each side, making the full diameter hole and allowing plenty of clearance for chips. The details of construction are clear from Fig. 3.

Cutters below 8 inches are made from solid tool steel, the smaller sizes, 4 and 6 inches, being cut from the inside of the 8-inch by a parting tool. This leaves them practically tool-steel rings, which are fastened on cast-iron backs for driving.

The photographs and details were supplied by the Water Works Equipment Company, New York.

Washer Dies and How to Make Them

By Pressman

It does not require a great deal of skill to make a punch or die to punch out a ring with a hole in it, but when that ring has a very perceptible "cup" to it and the hole has a ragged, burry edge, the washer degenerates to a "thing" and everyone is disgusted.

Now as to the cause of all this trouble. As the hole in the washer is punched first, too much clearance or a dull, rounded edged punch will cause both the cupping and the burring of the hole, and as the punches wear faster than the die an extra set, in first-class condition, should be kept on hand at all times.

Dies and punches for ⅜-inch washers are shown at *A*, *B* and *C*. These are what are termed doubles, that is, two washers are punched out at one revolution of the machine, the press making about 110 strokes per minute, so the operator has to hustle to keep up.

Making the Die

The clearance on the dies should be 1/16 inch between the hole in the die and the punch and in planing the die, it is well to leave the part surrounding the holes slightly higher. This admits of it being ground when the holes begin to wear which cannot be done if level.

This form of die is used on all washers up to and including ½ inch and is the most economical washer made, as it saves about one-third of the scrap and gives about one-half more product that a single line of washers.

The proper dimension for a ⅜-inch washer (manufacturers' standard) is outside diameter 1-inch, hole 7/16-inch, wire gage No. 14 (5/64) inch.

Repairing the Tools

When the dies and punches become worn the holes are closed in with a beading tool and the punches spread. The die is planed and the punch turned to size, the holes in dies reamed out carefully and then retempered.

In tempering the punches, the pilot should be soft so they will not break off which they frequently do when left with the usual temper in them.

At *D* and *E* are shown two sheets punched out in "doubles" for this size washer.

Making Mine Checks

It is a poor manufacturer who cannot find use for his machinery except to supply the one demand, and if the demand for washers is slack the press answers the same purpose for making mine checks. Quite a lot of them are used as we make from 100 to 200 kegs each year. One is

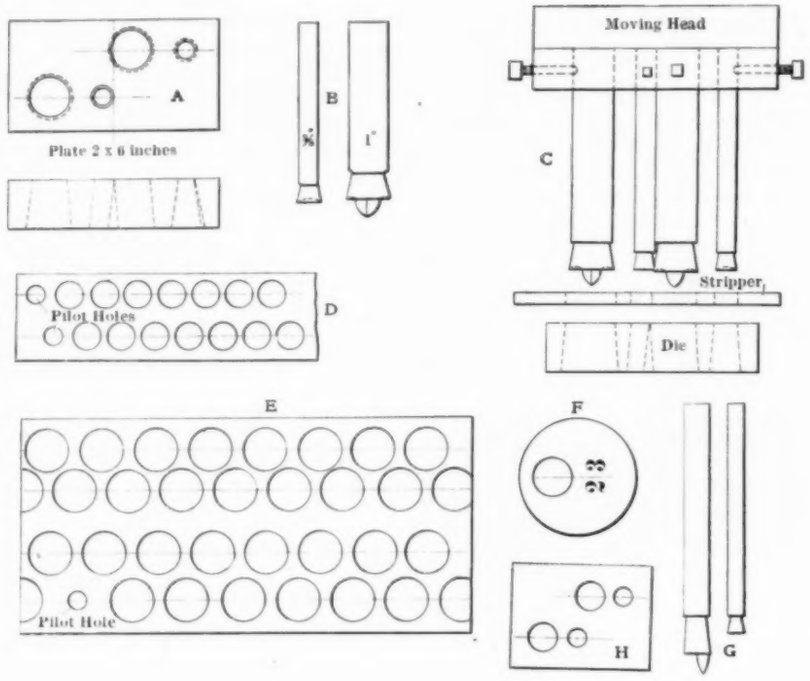


FIG. 1. MAKING SMALL WASHERS AND MINERS' COAL CHECKS

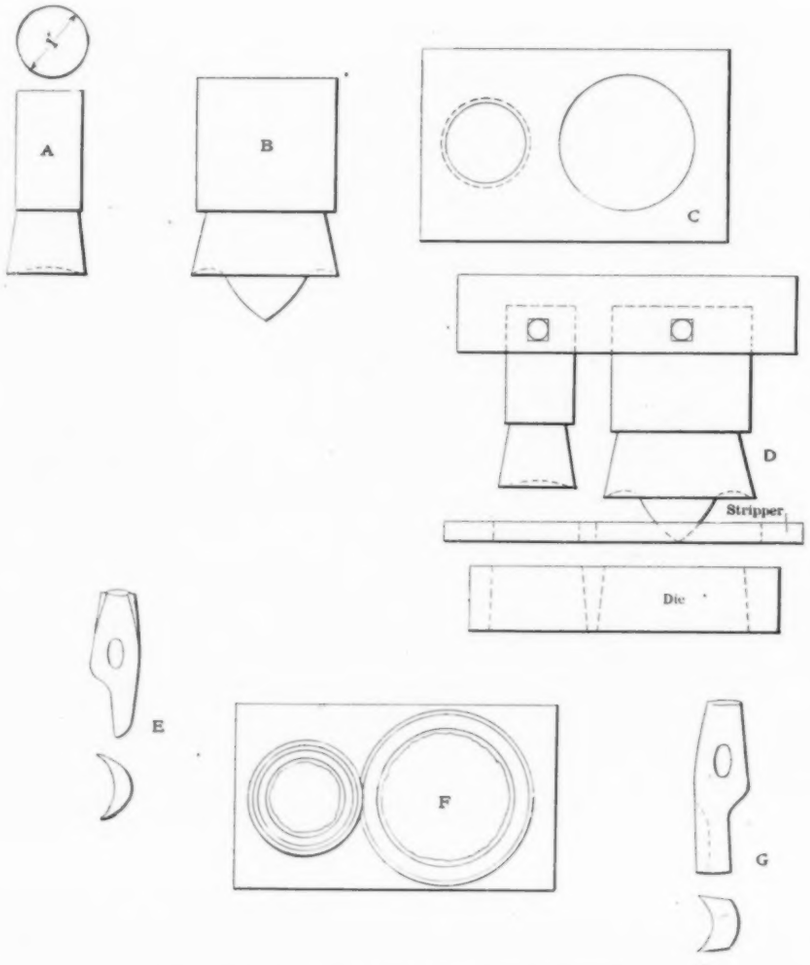


FIG. 2. DIES AND PUNCHES FOR LARGER WASHERS

shown at *F*, at No. 14 (5/64 in.) being used for this purpose. They are made in doubles and the pilot is shifted to within ⅛ inch of one edge as shown at *G*, Fig. 2. *H* shows the die and the sheets punched out with pilot hole look similar to a sheet punched for washers.

The miners use these checks to mark their boxes of coal as loaded. They are hung on the box and the weighman credits that number with the net weight of coal. Each miner carries about 30 of them and as they are continually being mislaid, lost and covered up, the demand for them is constant.

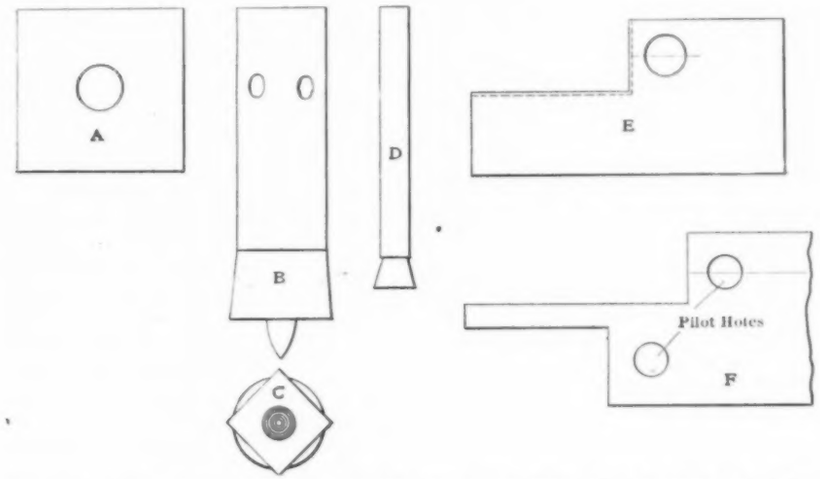


FIG. 3. PUNCHES FOR SQUARE WASHERS AND STRIPS FROM WHICH THEY ARE CUT

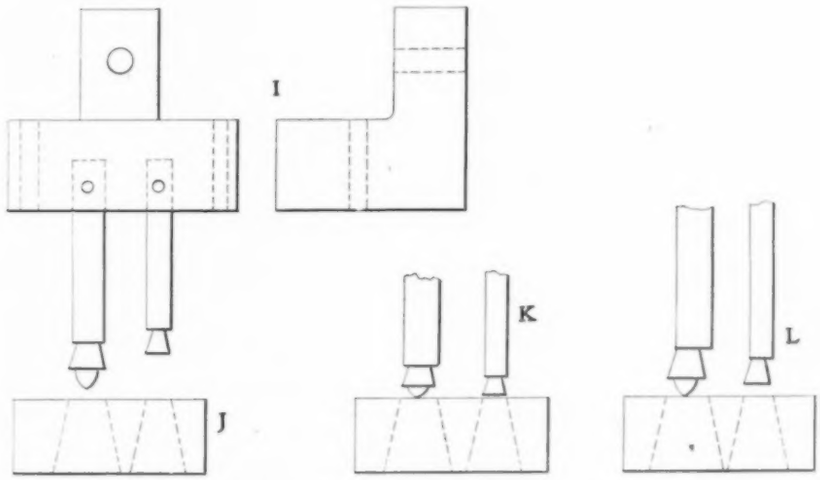


FIG. 4. ECCENTRIC PUNCHES FOR WASHERS

Larger Washers

In making 1-inch washers, the metal sheet is No. 9 wire gage (5/32 in.) 5⅛ inches wide and no longer than can be handled easily, say 36 to 40 inches. Punches are similar to those for smaller work but larger and heavier.

This washer is 2½ inches outside, 1 1/16 inch in hole, 5/32 inch thick. Punches and dies are shown at *A*, *B*, *C* and *D* Fig. 2. Dies are made from 2x6 inch stock. A well made die will stand for from 10 to 25 kegs of washers.

When the die wears it is beaded or peened with a set or hammer as at *E*. This gives it the appearance of *F*. It is then reamed out to correct size and re-tempered.

The punches when new are made as long as possible, as they wear faster than the dies and consequently need more dressing. They are spread by the tool shown at *E*, annealed, and turned true to size and re-tempered.

It may be asked as to why a web is left between each hole or why there is such a waste of material.

It has been found by experience that it is cheaper to waste the material than to take the time to get out the scrap and to run the risk of spoiling punches and dies by having pieces drop out, and jam under the stripper.

The material is a waste product from steel mills and comes in all sizes and shapes. The strips are sheared to size in a circular sheet shearing machine that does the work very rapidly. The washers after punching are put in a tumbling barrel. Then after a thorough polishing, they are dumped on a platform and all imperfect ones thrown out. They are then kegged and are really for shipment.

Square Washers

Square washers are out of the ordinary, but they are used to a considerable extent in telephone work, boat and barge building and some other lines and the demand seems steadily on the increase.

The method of making them is certainly ingenious and shows to what extent a man's mind can go, to overcome a difficult proposition and do work expeditiously and accurately, and at the same time make good use of the machinery at hand.

Fig. 3 shows a square washer with 9/16 hole, No. 14 sheet metal being used for the purpose.

Two views of the punch are given at *B* and *C* and in this case it acts as a shear blade also. *D* shows an ordinary 9/16-inch punch for center hole and *E* is the die and bottom shear blade. A section of sheet punched out is shown at *F*. The square punch with pilot in center, shears two sides of the sheet only, the side next the gage needing no shearing and the preceding washer having left a square cut, there is nothing for the punch to cut at that point, so the two sides next the operator are all that are acted on. A strip of iron about 3/16 in. wide is left to pull the sheet along by for the second row of washers.

The square punch will stand plenty of "cup" and the stem should have two depressions for the set screw, opposite each other so the punch can be turned when the cutting edges become worn. And as it wears faster than the die, this plan gives double life to it, which is quite a saving in a day's run.

The sockets for the punches are firmly bolted to the pendulum head, and as can be seen by Fig. 4 it is a lot of work to fit one. By a simple expedient, one socket head is made to do for three sizes of washers by turning the punch's eccentric. Take ¼-, 5/16- and ⅜-inch washers for example. One socket will do for the three sizes by offsetting the center hole punch, according to the difference of center of holes in the three dies. *J* shows socket die and punches for ¼-inch, *K* for 5/16-inch and *L* for ⅜-inch washers. Of course, the stem of the punches should be large enough to accommodate the offset, and if this is done, it saves work in fitting and changing socket heads on two sizes of washers.

A brass- and iron-bedstead factory, with a capital of $100,000, has located in Cornwall, Ontario. The city gave a bonus of $20,000.

AMERICAN MACHINIST

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The Timber Supply of the United States

A pamphlet which is likely to give pause to every American who reads it is circular No. 97, of the Forest Service of the Department of Agriculture, on the rate of depletion and the future prospects of our timber supply. It opens with a table of our output of forest products from which it appears that there are at present 35 billions of board feet of lumber cut in this country annually, and while the natural feeling is that coal has become the almost exclusive fuel used, the fact is that no less than 100 million cords of firewood are still consumed annually. The total value of forest products at the point of production is today over one billion dollars, the total quantity of wood cut to obtain the various products being not less than 20 billion cubic feet per annum. The cut has nearly doubled in 20 years, the figures for the total cut being 18 billion board feet in 1880, and 35 billion feet in 1900—an increase of 94 per cent. against an increase of 52 per cent. in population. Since 1880 more than 700 billion board feet of timber have been cut for lumber alone. Our annual consumption of lumber *per capita* is 400 board feet, while in Europe this average is but 60 feet. The circular gives an analysis of this great difference but it is no doubt chiefly due to our large use of wood in building construction, especially for dwellings—a use which is responsible for both the defection of our forests and for our excessive losses by fire.

A tabular exhibit of the sources of supply since 1850 is given in order to show the depletion of the forests of one section after another. From this table it appears that in 1850 the northeastern States produced 54 per cent. of the total supply, which figure has now been reduced to 16 per cent.; in the meantime the lake States have advanced from 16 to 27 per cent, and the Southern States from 14 to 25 per cent. With this shifting of the source of supply there has, of course, been a change in the kind of lumber produced. There was a time when white pine alone constituted one-half of the total cut, whereas in 1900 its figure had dropped to 21 per cent., and in 1904 to 15 per cent. of the total cut.

Regarding the supply which remains, knowledge is very deficient. Various estimates have been made, but the magnitude of the task and the many difficulties involved have prevented the gathering of the necessary data for an authoritative statement.

The most trustworthy estimate is probably that of the census of 1900, which gave the remaining stumpage of the United States as 1,390,000,000 M board feet, figures which were increased in the estimate of the *American Lumberman*, of 1905, to 1,970,000,000 M board feet. Too much reliance should not, however, be placed upon these figures, as in the past, the actual cut of certain sections has materially exceeded the estimates of the standing timber. Thus the census estimate of the stand of white pine in the lake States in 1880 was less than 88 billion feet, but actual reports show the cut since that date to have exceeded 170 billion, and the amount yet standing is now estimated at from 50 to 60 billion feet. Again, since 1880 Minnesota has supplied four times the quantity estimated to be then standing, and the State is today furnishing over one-third of the white pine cut in the entire country.

Despite these discrepancies, however, there is no doubt that the days of white pine are rapidly passing and that in a few years it will cease to be a large factor in the timber supply of the United States—the total cut today being less than one-half that cut in the lake States alone in the latter eighties. Since 1895 248 firms, representing an annual output of 4½ billion feet of pine lumber, have retired from business because of the exhaustion of their supplies. The cut of yellow pine is, however, still on the increase, and its maximum has probably not yet been reached, but there is little doubt that in the course of 10 or 15 years it will repeat the story of white pine.

Regarding the replacement of the forests by natural growth the pamphlet states positively that our present annual consumption of wood in all forms is from three to four times as great as the annual increment of the forests, and it would appear to be certain that the time is not distant when there must be a great curtailment of the use of wood if the present methods of forest exploitation are continued, the probabilities being that the maximum annual yield of forest products for the entire country has been reached, and that in the near future there will be a marked decrease in the total product, as there is now of several items. Since 1892 the price of white pine has nearly doubled, and the price of yellow pine has increased nearly 70 per cent.

The concluding opinion of the report is that the forest area of the United States is sufficient if rightly managed, to produce eventually timber enough for every legitimate need, but that, as has been stated already, the present annual increment is only about one-third of the annual consumption. In this matter, as in so many others, we must turn to Germany for instruction, and an illustration of what can be done. Of course, the enterprise of re-forestation is a case of planning for the long future; but it has been successfully done in Germany, and there seems to be no reason why it cannot be done here, although in the meantime we are pretty sure to experience no less than an absolute timber famine.

The Dewey System of Indexing for Technical Literature

In our last issue we published a notice of the very praiseworthy extension of the Dewey system to the indexing of technical literature, by Professors Breckinridge and Goodenough. The columns of the AMERICAN MACHINIST, as well as the *Transactions* of the American Society of Mechanical Engineers, and the current *Index to Technical Literature*, published by the *Engineering Magazine*, testify to the importance of the subject of indexing technical literature and the wide interest in which it is held.

There is no doubt that after a collection of literature of any kind has reached a certain volume the alphabetical system of indexing becomes unsatisfactory, the fundamental difficulty with that system being that it is necessarily a title and not a subject system. When referring to such an index, one is, sooner or later, confronted with the chronic difficulty that he cannot remember the title of the article or book which he desires to find—the general subject only being all that he can recall—and in many cases he soon flounders in a sea of despond. The fundamental merit of the Dewey system is that it provides a subject and not a title index. It begins with the broadest possible classification of human knowledge and then by subdivision and re-subdivision it narrows down the search by constantly converging lines, making the hunt for any book or article almost unerring.

Now that the libraries of the mechanical, mining and electrical engineers are consolidated in the new Carnegie Engineering building, their re-indexing will necessarily be undertaken as a matter of course, and we certainly hope that this will be done under the Dewey system. The classification of Professors Breckinridge and Goodenough furnishes an easy and sure starting point for the work.

An Epidemic of Broken Rails

In connection with the large number of railway accidents which have occurred in this country in the past few months, a report recently issued by the State commissioner of New York relative to the tremendous increase in the number of broken rails found on different steam lines operated throughout the State is of prime importance, and should be of interest to every reader. According to this report, during the first three months of the present year there were removed from the tracks of the principal railroads of the State no less than 3014 broken rails, while during the corresponding three months of 1906 there were but 826 breakages. In the first three months of 1905 the number of breakages totaled 1331.

The investigation by the State board was undertaken at this time because of the unusual number of rails reported broken during the past winter, and the report in detail was presented to the American Railway Association at its recent convention in Chicago, with the request from the board that the association take the matter up for discussion and arrange a conference with the rail manufacturers with a view to ascertaining if the increasing number of breakages be due to manufacturing methods or composition of material. It is announced from Pittsburg that steel-rail makers deny the statement made at the convention that defective rails are responsible for most of the wrecks occurring in this country, and the claim is made that the best steel rail ever rolled is manufactured at the present time. One of the tables compiled by the commission apparently shows the greatest breakage totals in rails made since 1899, and particularly in those rolled in the past three years. Whether the increase in breakages is due entirely or in part to defects in the rails or to increased strain arising from the operation of faster trains and the handling of heavier traffic, or to both, is a question likely to bring out some interesting discussion before it is definitely settled.

The American Society for Testing Materials

The tenth annual meeting of this society will be held at Atlantic City, June 20 to 22. The headquarters will be at the Hotel Chalfonte.

The society is now in a flourishing condition, its membership, after making all deductions, being 880.

William J. Johnston

William J. Johnston, proprietor of the *American Exporter*, died very suddenly of cerebral hemorrhage, at his residence in this city, April 29, aged 54 years.

Mr. Johnston was born in Ireland and came to this country when 15 years old. After some work as a telegraph operator, he started a journal called the *Operator*, which subsequently developed into the *Electrical World*. After selling his interest in that paper he spent some time in travel, and then started *Mining and Metallurgy* in New York, which was later consolidated with the *Engineering and Mining Journal* through the Johnston Publishing Company, of which he was president. He retired in 1904 and started the *Mining Magazine*, which he sold two years later to the Hill Publishing Company. He became owner of the *American Exporter*, of which he was publisher up to the time of his death. Mr. Johnston had a thorough knowledge of the publishing and advertising business, and was successful in several of his ventures. He leaves a widow, four sons and two daughters.

William H. Derbyshire

William H. Derbyshire, president of the Chambersburg Engineering Company, died April 13.

Mr. Derbyshire was born in Canton, Ill., March, 1859. After graduating from the Polytechnic College of Pennsylvania, in 1877, he entered the employment of the John Roach & Sons ship and engine building works at Chester, Penn., remaining with those works until 1879. He then engaged with Frederick B. Miles, of Philadelphia, and remained with him until August, 1885. When the consolidation of the Miles works with those of William B. Bement & Sons took place, he became general superintendent of the works and remained there until November, 1897, when he formed the Chambersburg Engineering Company, of which he was president until his death.

Mr. Derbyshire was an authority on smith-shop and boiler-shop equipment and after organizing the Chambersburg works, he gave his entire time and attention to this class of machinery, in which he took out many patents. Of these the best known is his system of quick-acting hydraulic riveters and presses, the merits of which have led to a large sale. He also devoted much attention to steam hammers, and the machines of his design contain many points of merit. He developed the steam drop hammer to a high state of perfection, which has been reflected in a large sale.

The works under his management grew rapidly from a small beginning to its present dimensions, with over 400 employees. It includes a large machine shop and foundry, as well as an open-hearth steel-casting foundry of large capacity. Mr. Derbyshire was a superior organizer and had gathered about him a well trained force of skilled mechanics and engineers; and while his loss is a severe one, it is not expected to interfere with the operations of his company.

A new method of cutting steel has been patented by a Belgian engineer. The process consists in first heating the metal by means of an oxy-hydrogen flame and then cutting it by a small stream of oxygen gas, which unites with the steel and forms a fusible oxide; in this condition it flows freely from the cut. The operation is made continuous by revolving the pipe and employing two jets, one containing oxygen and hydrogen, and the other containing pure oxygen, which follows close in the path of the former. The oxy-hydrogen flame raises the metal to a red heat, and the following stream of oxygen then makes the cut. It is said that the cut is fully as smooth as that made by the saw, and is only 1/100 in. wide.—*The Mechanical World.*

Tests of a Speed-change Gear Box

Efficiency of an Automobile Transmission Box Shown to Decrease with Increase of the Speed Ratio and to Fall Off Markedly in Reverse Gear

BY RICHARD C. WILLIAMS

Tests of motive engines of every conceivable type for automobiles are common and though it is the efficiency of the power plant itself which is the essence of economy in propulsion, it will occur on second thought that the really available, useful power is that which gets as far as the differential gear on the rear axle. This fact is appreciated by manufacturers and in the advertising of some will be found guarantees of transmission efficiency, depending upon boldness, of from 90 to 98 per cent. The bare statement of a percentage, however, does not carry weight or information of any value, for the load or speed is not stated.

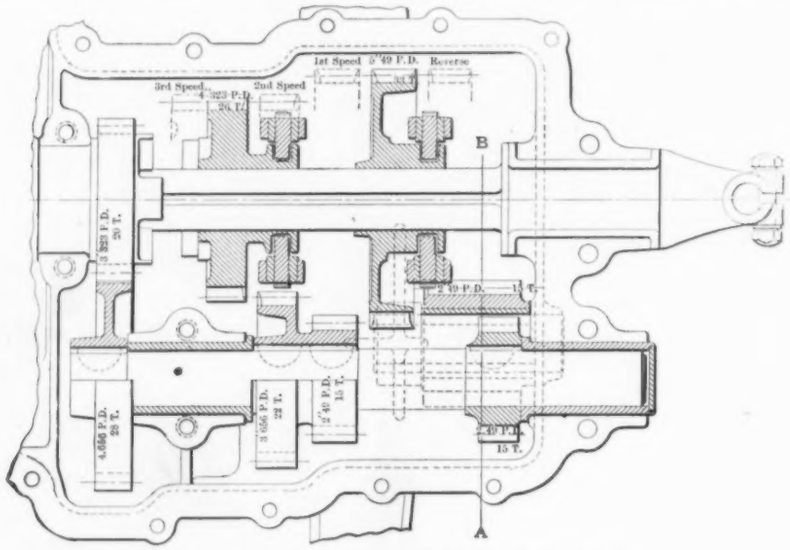

FIG. 1. PLAN VIEW OF SPEED-CHANGE GEAR BOX

Previous to these tests correspondence with many manufacturers brought to light that either they had not actually tested their transmission or speed-change box or did not wish to disclose the results, neither could they refer to any who had or would. Then, too, a search of indexes of both American and foreign engineering and automobile papers failed to discover any records of tests on this part of chassis anatomy.

The tests in question were made about a year ago at the mechanical engineering laboratory of the Worcester Polytechnic Institute by Daniel A. Harrington, Jr. and the writer, with the best equipment and instruments that could be secured and with suggestions as to the most useful nature of tests from the makers of several well known cars.

The transmission which was chosen was of the type placed by the Electric Vehicle Company, of Hartford, Conn., in its 18 horse-power 1905-model Columbia gasolene car. Reference to the drawing Fig. 1 and half-tone, Fig. 2 of the transmission will show that it does not differ essentially from that placed now on the market. It will be noticed that the construction of the housing is such that it can be readily and securely bolted to a testing frame.

At first thought it will seem queer that a transmission was chosen which had never been in actual service on a car and which showed practically no signs of wear, but careful reason for this will be shown. The box had, however, been run more or less with an engine on a show stand in an agent's garage, which had limbered it somewhat. It was suspected that the bearing losses would be at a maximum in a practically new box and that therefore if it were found that the gear losses were low it would be the easier to differentiate between them, when the results of the tests were figured up and curves plotted. Since the object of the experiment was to find whether the gear loss was high or low, the experimenters consider themselves fortunate to have made the preliminary "estimate" which was little better than a guess, on the bearing efficiency.

The gears were lubricated during the test with good vaseline and heavy machine oil; bearings were supplied copiously with a light bearing oil. As far as could be discovered the action of the clutch was perfect inasmuch as the shoe and cup were prick-punched at the start and frequent inspection failed to show slippage.

The Arrangement of the Apparatus for Testing

A new 10 horse-power General Electric Company induction motor with a rated speed of 1200 r.p.m. was mounted on one end of a well bolted frame of 6x6-inch spruce. Current was supplied (through a switchboard for instrument connection) at 220 volts pressure and 60 cycles. Two new Wagner

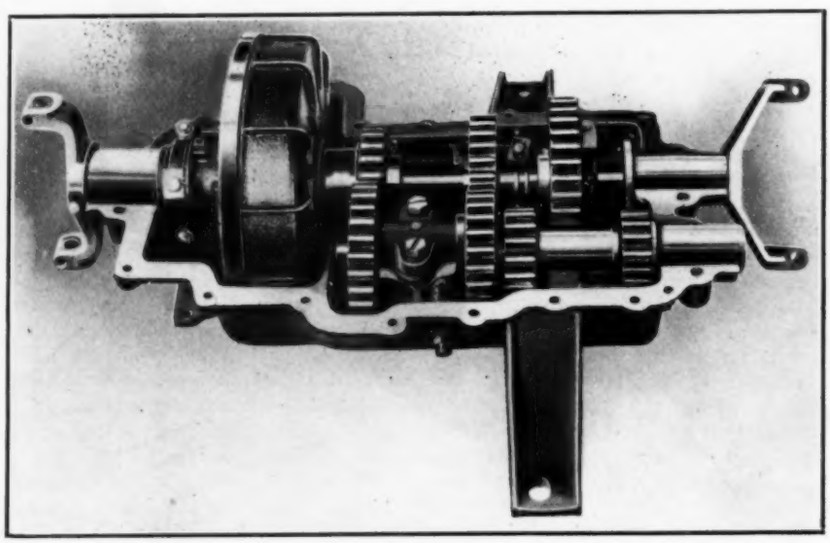

FIG. 2. THE TRANSMISSION-GEAR BOX; TOP HALF OF HOUSING REMOVED

wattmeters, calibrated for testing work by the makers, measured the power supply, one instrument being placed in each phase and connected through transformers to give a very delicate reading. On the middle of the frame was mounted the transmission gear and at the farther end was swung between two bearings on a 1 15/16-inch shaft, an 18-inch Alden dynamometer, with one disk, to supply the load, both for the calibration of the motor and for the test of the transmission to follow. To the end of the dynamometer shaft was connected a revolution counter to be used in connection with a stop-watch as the most accurate means of determining the average speed during any given test. (See Fig. 3).

The Alden Dynamometer is not in as common use by engineers as its merits would seem to demand—possibly because the machine is considerably more expensive than a makeshift Prony brake, and in some cases would be inconvenient to attach, since it must be slipped on over the end of the shaft. However, for a continued test nothing could be better to supply a friction load which can be at all times accurately balanced by hand—or automatically if so desired. The friction is between a cast-iron disk keyed to the revolving shaft within the outer housing of the device and copper plates attached to the housing, which latter carries the lever with the weight pan at its outer end. The copper plates are forced against each side of the revolving disk by means of hydraulic pressure maintained in the chambers between each plate and the corresponding side plate of the housing. Lubrication between the disk and the copper plates is provided by oil, thick or thin, depending on the load to be imposed. The water pressure is regulated by inlet and outlet valves controlling the flow through the dynamometer, which is cooled thereby. Water for the dynamometer was taken from the city high-pressure line, and not a little annoyance was experienced by the fluctuation of the pressure. This was attributed to several hydraulic elevators being operated from the line or some similar demand, which lowered the pressure quickly. It required constant attention to prevent the brake from being "set" by a sudden rise in pressure. An ideal arrangement would have been to take water from an accumulator or air tank.

As with a Prony brake, calculation with weights, distance of knife edge of scale pan from center of rotation and the revolutions per minute will give the horse-power being absorbed.

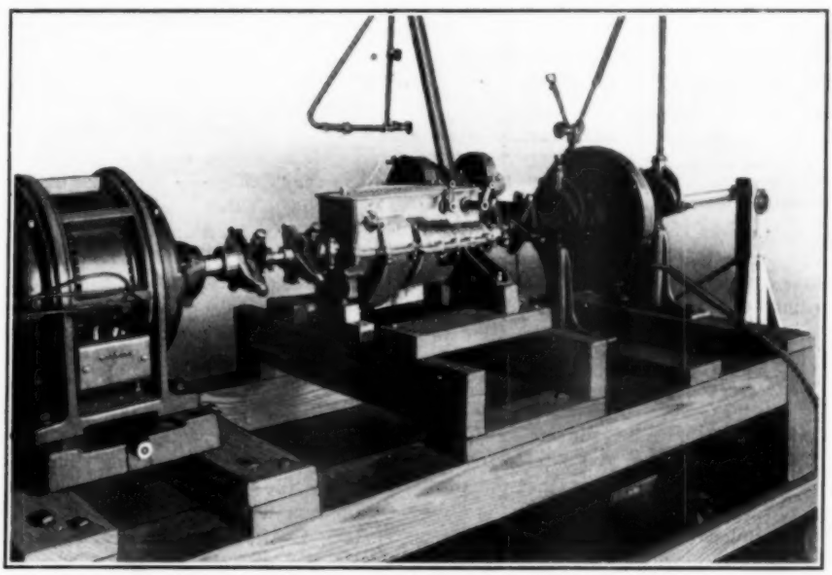

FIG. 3. SET-UP OF APPARATUS READY FOR TEST

Determination of Motor Efficiency, Transmission Gear-box Not Used

In order to thoroughly know the performance of the motor, and to give a starting point in the determination of the efficiency of the gear-box the motor was calibrated both before and after the tests on the transmission, by connecting it, through universal joints and a short shaft without bearings, to the dynamometer and submitting it to a series of loads noting the resulting watt readings and revolutions from which the horse-power, efficiency, etc., could be figured. The results, plotted graphically, are shown as the "motor calibration curve," in Fig. 4 It will be noted from this curve that loads of a little over 19 horse-power were taken from the motor, but at this capacity it must be remembered that the load was applied for only three minutes at a time, and hence no injury to the motor resulted. The reader might remark, "but the operating efficiency of this motor must have been lowered." The answer to this is: "Surely, but the efficiency of the transmission was the same while it was being tested as when the motor was being calibrated, and we are only concerned in knowing the actual brake horse-power which the motor would develop with a given electrical horse-power supplied."

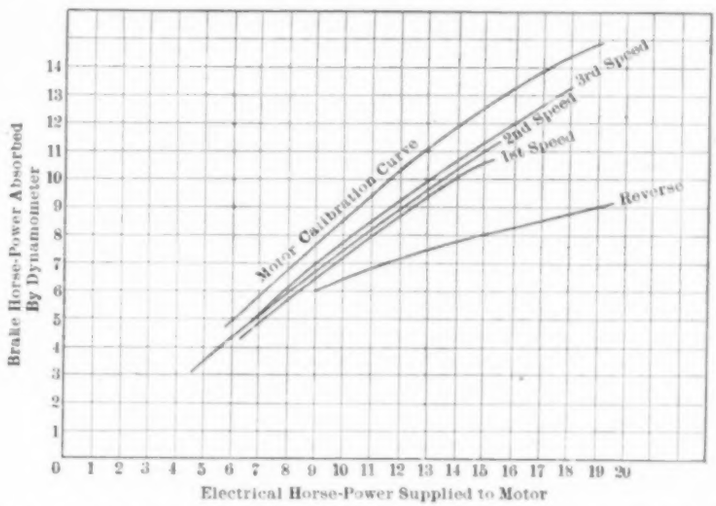
Brake Horse-Power Absorbed By Dynamometer
Electrical Horse-Power Supplied to Motor
Motor Calibration Curve
1st Speed
2nd Speed
3rd Speed
Reverse
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 2 3 4 5 6 7 8 9 10 11 12 13 14

FIG. 4. CURVES SHOWING BRAKE HORSE-POWER AT VARIOUS ELECTRICAL HORSE-POWER INPUTS

Manner of Conducting the Tests

The revolutions were taken, not because it was a vital thing to know, coupled with the efficiency of the gear, but as a necessary factor in figuring up results.

Several hundred tests were run to give a complete series of points on which to plot the curves showing the performance Fig. 4, and to check each load chosen to prove beyond doubt the correctness of the data, the load being increased step by step to the maximum and then decreased, thus returning on the same curve. In no case did the data obtained vary more than 1 per cent. from the previous readings. The time of duration of each test was three minutes, the test not being begun till several minutes after the motor had been started, to allow everything to come to a running equilibrium as far as inertia, warming the bearings, etc.,

was concerned. Electrical readings were taken each half minute only, as they were found to be quite constant, due to the fact that the motor was operated from an independent generator. In running the test of the "reverse combination," the weight, of course, could not be hung on the lever of the dynamometer, and, although the lever could have been attached on the opposite side of the housing, this was not done, as for other reasons it would have been inconvenient. Instead, a vertical strut was placed under the lever, the lower end of the strut resting on the platform scales on which the weight was set to equal the load to be to it, which is transmitted to the dynamometer, that is the percentage of the actual brake horse-power generated by the engine, when in use in a car, which would reach the rear axle. Graphical representation of these horse-powers are the ordinates on Curve Sheet No. I (Fig. 4). Choose any point on the "calibration curve" and the vertical distance to that point from the zero axis represents the actual horse-power delivered to the transmission. Points on the other four curves directly under the point chosen show the amount of power delivered by the speed-change box when transmitted through either the third, second and first or reverse combination. The ratio of these ordinates or vertical distances is the efficiency for that particular speed combination and amount of power supplied.

Electrical Horse-Power Supplied	Brake HP. Absorbed by Dynamometer				Calibrated Brake Horse-Power	Efficiency of Gear			
	3rd Sp.	2nd Sp.	1st Sp.	Reverse		3rd Sp.	2nd Sp.	1st Sp.	Reverse
7	5.20	5.12	4.86	—	5.90	88.1	86.8	82.4	—
9	6.94	6.68	6.44	5.98	7.65	90.7	87.3	84.2	78.2
11	8.50	8.21	7.92	6.80	9.44	90.0	87.0	83.9	72.0
13	9.95	9.64	9.35	7.48	11.10	89.8	87.0	84.3	67.5
15	11.34	11.00	10.60	8.02	12.55	90.4	87.6	84.5	63.9
17	12.65	—	—	8.55	13.89	91.0	—	—	61.6
19	—	—	—	9.02	14.90	—	—	—	60.5

FIG. 5. READINGS FROM CURVE SHEET FIG. 4. TO PLOT CURVE SHEET FIG. 6.

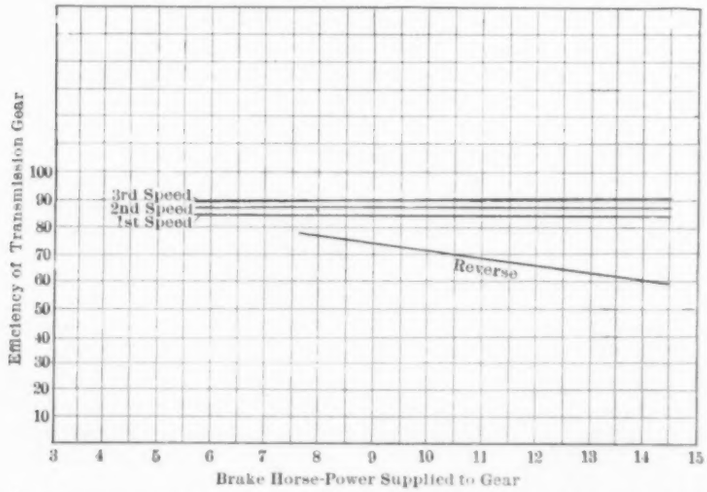

FIG. 6. EFFICIENCIES OF TRANSMISSION GEAR AT VARIOUS LOADS AND SPEED RATIOS

run and by regulating the water pressure the brake was balanced against this.

Plotting the Efficiency Curves from the Horse-power Curves

From the curves between electrical horse-power supplied to motor and brake horse-power absorbed by dynamometer must be plotted the efficiency curves in order to show plainly the entire performance of the gear. Fig. 5 is a table of Readings from Curve Sheet No. I (Fig. 4), from which the efficiency for each "power supplied" position was figured. These efficiencies are also given in the same table, and hence Fig. 5 is a tabular representation of both Curve Sheet No. I and Curve Sheet No. II. It is obvious of course that the efficiency of the gear is the percentage of horse-power supplied

Conclusions

The efficiencies as shown on Curve Sheet No. II, Fig. 6, give rise to the following conclusions: First, that the third speed (direct drive through positive clutch, no gears transmitting power) gives a slightly increasing efficiency with an increase of horse-power transmitted—from 89.9 per cent. with 6 horse-power supplied to 91.1 per cent. with 14.5 horse-power supplied. Second, that on the second (intermediate) speed the efficiency at 6 horse-power of 87 per cent. increases scarcely any when transmitting more power. Third, that on the first (lowest) speed the efficiency of 84 per cent. is constant. Fourth, that with reverse combination an efficiency of 78 per cent. at 7.5 horse-power drops to 60.5 per cent. at 14 horse-power supplied.

In conclusion we may say with certainty that the larger portion of the loss is in the bearings and not in the gears. This is drawn from the fact that the curves of the third, second and first speeds lie so closely together. Added to this is the fact that there is such a decided drop in the efficiency curve for the reverse combination. In the latter case there can be no question but that this is a true gear loss due to the power passing through so many gears at high speed.

It is the regret of the experimenters that time did not permit of continuing the investigation with another transmission well worn from service in a car, and also some other type with ball or roller bearings as a comparison.

The Spring Meeting of the American Society of Mechanical Engineers

The spring meeting of the Mechanical Engineers will be held in Indianapolis, Ind., May 28 to 31. The official program to which, however, some additions are to be expected, is as follows:

The opening session will be held Tuesday evening, May 28, in the auditorium of the Claypool hotel, and will be devoted to an address of welcome, with a response by President Hutton, following which there will be a social reunion. The business session will be held Wednesday morning, at which will be presented a report of the committee on Standard Proportions for Machine Screws, and the preliminary report of the committee on Refrigerating Machines, following which will come papers on the "Collapsing Pressures of Lap-welded Steel Tubes," by R. T. Stewart, "The Balancing of Pumping Engines," by A. F. Nagle, and "A Comparison of Long and Short Rotary Kilns," by E. B. Soper. Wednesday afternoon will be devoted to visits to various manufacturing plants, while the evening session will be devoted to an automobile symposium, to which Henry Hess, John Wilkinson, Elwood Haynes, T. J. Fay and B. D. Gray will contribute. Thursday morning will be devoted to the subject of "Superheated Steam," on which four papers by A. R. Dodge, A. M. Green, E. H. Foster, and R. P. Bolton are promised. Thursday afternoon will be devoted to an excursion and Thursday evening to a reception. On Friday morning there will be an excursion to Purdue University, at Lafayette, where a session for the reading of papers will be held, the papers promised being on the "Performance of Cole Superheaters," by W. F. M. Goss, "Experiences with Su-

perheated Steam," by G. H. Barrus, the "Use of Superheated Steam on Locomotives in America," by W. H. Vaughan, "Superheated Steam in an Injector," by S. L. Kneass, "A Hirn's Analysis of a Locomotive Test," by S. A. Reeve, and "The Heating of Storehouses," by H. O. Lacount.

New Publications

THE AMERICAN MANUFACTURER AND THE CONSUL. By Paul T. Cherington. 11 7x10-inch pages. The Philadelphia Commercial Museum.

This pamphlet is the outgrowth of a trip made by the author during the past spring and summer in the interests of the Philadelphia Commercial Museum, during which visits were paid to a score or more of the American consulates in the leading commercial centers of England and the continent of Europe. The pamphlet gives the results of the author's observations and endeavors to point out the tangible services which consuls can give to manufacturers, the sort of questions which a manufacturer may properly ask of a consul, the methods of using such information to the best advantage and the limitations of the service at its best. He points out the failure of American manufacturers to secure any large success in export trade, and says that no great amount of experience is necessary to convince one that most of our foreign trade troubles are due less to separation by distance and to difference in commercial conditions than to ignorance. Manufacturers who are brilliantly successful in domestic trade make failures in their efforts to secure foreign business because they do not know how. The author gives large praise to consular officers, saying that those visited were found almost without exception to be alert, energetic Americans who were thoroughly alive to the responsibilities and the possibilities of their work, and he concludes that the consular service as it stands is capable of extremely profitable use and endeavors to show how such use can be made of it.

Personal

W. M. Fawcett, superintendent of the Julian Scholl & Co. shops, Kingston, N. Y., has accepted a position as mechanical engineer with the Stearns Company, Erie, Pennsylvania.

J. C. Horne, for the past two years superintendent of the Boston Gear Works, has resigned to take an extended trip through the West. After his return he will organize a company and start a manufacturing plant in Boston.

E. T. Trefethen, formerly superintendent of the A. O. Norton Company, Boston, Mass., has organized and formed a partnership which will be known as Chadwick & Trefethen, Portsmouth, N. H. They will make a line of expanding reamers, expanding chucking reamers and expanding mandrels.

John W. Seaver, vice-president of the Wellman-Seaver-Morgan Company, for several years, has resigned his position. Mr. Seaver has opened offices as consulting engineer in the Caxton building, Cleveland, and will devote himself to the design and construction of machinery for handling material, iron and steel foundries, as well as manufacturing and power plants.

Obituary

M. L. Hinman, for several years president of the Brooks Locomotive Works, died at Dunkirk, N. Y., May 3, aged 66 years. With the late Horatio G. Brooks, Mr. Hinman founded the locomotive works and up to 1901, when it was merged with the American Locomotive Company, was secretary and treasurer of the company.

Business Items

The New York office of Alfred H. Schutte has been removed to 90 West street.

On May 1, Norton Company and Norton Grinding Company, Worcester, Mass., opened a store at 48 South Canal street, Chicago, for the sale of their products.

The Whiting Foundry Equipment Company, Harvey, Ill., has appointed H. W. Canning, southern representative, with headquarters in the Brown-Marx building, Birmingham, Alabama.

The Texas State Penitentiaries recently installed a 10-ton, 3-motor, electric jib crane in the pipe foundry connected with that institution. The crane was furnished by the Northern Engineering Works, Detroit, Mich.

The Northern Engineering Works, crane builders, Detroit, Mich., have furnished the power plant of the Edison Sault Electric Company, Sault Ste. Marie, Mich., with a 15-ton alternating current electric traveling Northern crane.

The J. D. Smith Foundry Supply Company, Cleveland, Ohio, has purchased the plant and property of the Variety Iron and Steel Works adjoining its present facing mill. This will be used to take care of its growing equipment business.

Chadwick & Trefethen, Portsmouth, N. H., have purchased the good will, patents and plant of G. B. Charwick & Co., of that city, and they will continue to make the line of expanding reamers formerly made by that company, and will also manufacture a new line of expanding chucking reamers and expanding mandrels.

The San Francisco office of the General Electric Company is now permanently located in the Union Trust Building, San Francisco. Since the fire, the office has been located in the Union Savings Bank Building at Oakland, large temporary warehouses having also been erected in the same city.

The Hisey-Wolf Machine Company, Cincinnati, Ohio, manufacturers of portable electrical drills and grinders, are proceeding with the erection of their new plant, and expect to have it ready for occupancy by October 1. The main machine shop will have a frontage of 90 by 165 feet, three stories high.

Blood Bros. Machine Company, manufacturers of universal joints and steering gear, have again found it necessary to increase their facilities to keep up with the rapidly growing demand for their goods. When the new buildings they are erecting are completed, their capacity will be doubled.

Trade Catalogs

J. M. Smith, 568 St. Marks avenue, Brooklyn, N. Y. Circular illustrating and describing the Bryar friction lock-nut.

American Locomotive Company, New York. Catalog of Mogul type freight locomotives. Illustrated, 60 pages, 6x9 inches, paper.

Pittsburg Automatic Vise and Tool Company, Pittsburg, Penn. Booklet describing the Pittsburg automobile vise. Illustrated, 4¼x6½ inches, paper.

Boston Gear Works, Norfolk Downs, Mass. Catalog B and Price List of standard gears, universal joints, steel balls, etc. Illustrated, 58 pages, 5x8 inches, paper.

J. W. Paxson Company, Philadelphia, Penn. Bulletin No. 16, describing the "Outerbridge" silicon alloy for softening, strengthening and cleaning cast iron.

Crane Company, Chicago, Ill. Pamphlet briefly reviewing and illustrating some of the more important lines of valves, fittings and special appliances. 96 pages, 4x7 inches, paper.

The Billings & Spencer Company, Hartford, Conn. General catalog of machinists' tools, etc. Illustrated, 119 pages, 5x7½ inches, paper. Catalog of fine tools and specialties. Illustrated, 23 pages, 5x7½ inches, paper.

Manufacturers

The New Haven (Conn.) Clock Company, will build a $11,000 addition.

The Capital Lock, Nut and Washer Company, Columbus, Ohio, will build a new addition.

The Union Steel Screw Company, Cleveland, Ohio, will double the capacity of its plant.

The Atlanta Refining Company, Philadelphia, Penn., will erect two additions to its plant.

The Fort Wayne (Ind.) Electric Company will build a new four-story factory with two wings.

The Diamond Chain Manufacturing Company, Indianapolis, Ind., will erect a new factory.

Plans have been filed for a new plant for the Rushmore Dynamo Company at Plainfield, N. J.

It is reported that the Marshall Boiler Works, of Dubuque, Iowa, intend to erect a new plant.

The plant of the Magnolia Stove Works, Memphis, Tenn., recently burned, will be rebuilt immediately.

The Johnston Harvester Company, Batavia, N. Y., will build a malleable iron foundry in connection with its plant.

Trainor Carriage and Implement Works, has been incorporated at Little Rock, Ark. Capital, $15,000. G. G. Dood, president.

A new factory building to be used for the manufacture of springs will be erected for the J. G. Brill Company, Philadelphia, Penn., carbuilders.

The Witte Iron Works, Kansas City, Mo., has awarded contracts for the construction of new plant to manufacture gas and gasolene engines.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper catalog free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Export; would represent some more specialties in Germany; leaving next August. Box 955, AMERICAN MACHINIST.

Wanted—Firm to manufacture and market a developed line of gas engines on royalty, or will sell with patents. Box 937, AM. MACH.

Manufacturers desirous of establishing works in England should apply to W. H. Booth (of London), care AMERICAN MACHINIST, New York, for best location.

Sliderule taught, new and easy method; table of squares by 1/16, complete to last decimal, 25c. F. F. Nickel, 150 Nassau St., New York.

Wanted to swap a first-class ten horsepower steam engine for lathe, milling machine or drill press. F. A. Bentley, West Point, Miss.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—A responsible concern to place on the market a material for case hardening which revolutionizes present methods. Address "Inventor," AMERICAN MACHINIST.

Arrange with us to do your manufacturing; we build special machinery, special tools, etc. Lewis Blind Stitch Machine Company, 502 North Commercial St., St. Louis, Mo.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Foundry corporation having large contract for automobile cylinders, pistons, etc., desires to connect with progressive machine shop equipped to do necessary machining; no assembling. New England. Care AMER. MACH.

New Process; U. S. A. patent for sale; important machine adopted by British and foreign governments, carrying out new process and selling at $500; the machine and its product have large and profitable sale among tool users. Box 941, AMERICAN MACHINIST.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers, 146 West 56th street.

Advice; mechanical, practical and technical; tell me your needs. I'll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y., U. S. A.

The shops of the Motor Car Specialty Company, at Trenton, N. J., in addition to building speed meters and other high-class speed recording instruments, are open for the manufacture of light high-grade machinery, on contract or royalty basis, either in large or small quantities.

A German gentleman; age 30; civil engineer by profession, is desirous of making arrangements with American manufacturers of electrical or building construction machinery for the sale of their goods in Germany; will be in this country about May 1 for a few weeks. Address Box 896, AMER. MACHINIST.

Wanted—Manufacturing rights for article requiring very little machining, preferably none; material to be high-grade grey iron weighing 10 to 300 pounds; something for which wide market can be established; will consider patent, royalty, contract, or Eastern rights. Address "Founder," care AMERICAN MACHINIST.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent wishes to make a change, accustomed to fine and medium heavy interchangeable work; a designer of modern tools, jigs, and special machinery for rapid production. Box 899, AMERICAN MACHINIST.

Superintendent or assistant; excellent toolmaker and designer of labor-saving devices; wide experience on interchangeable work and metal specialties; executive ability and excellent manager of men. Box 956, AM. M.

Superintendent wishes to make a change; will consider any position of responsibility; a designer of modern tools, jigs and fixtures; familiar with cost keeping system, executive ability and excellent manager of men. Address Box 908, AMERICAN MACHINIST.

ILLINOIS

A young man, who is tool maker and machinist, desires position with mechanical exhibit at Jamestown Exposition. Box 948, AMERICAN MACHINIST.

Foundry and machine works superintendent, broadly qualified; 35 years practical and technical experience; proved executive and business ability; seeks responsible position in small or medium sized city: ample references; salary an object. Address "Widower," AMERICAN MACHINIST.

MASSACHUSETTS

Designing draftsman wants to change; experience in automatic tool machinery, fixtures and jigs for duplicating work; Massachusetts preferred. Address "H. R.," AM. M.

Manager or master mechanic open for engagement; wide experience and business acumen; money making results from men and materials; constructive policy; do not require ideal conditions; age thirty-two, married. Box 946, AMERICAN MACHINIST.

Mechanical engineer and practical toolmaker wants position as chief draftsman or foreman; experience, 3 years as chief draftsman with the Taft-Peirce Co.; five years chief draftsman and foreman of tool-making department with Schaum & Uhlinger, Philadelphia, four years toolmaker at Brown & Sharpe; expert organizer of rapid production; technical education; employed; married; references; 38 years of age. Address Box 942, AMERICAN MACHINIST.

NEW JERSEY

General foreman; high-grade duplicate work; tool designer; water meter work a specialty. Box 947, AMERICAN MACHINIST.

Mechanical draftsman; age 28; shop experience, earning $100 per month wants better position; now assistant to superintendent in manufacturing; will travel. Address Box 957, AMERICAN MACHINIST.

NEW YORK

Draftsman wants position; complicated machinery or jigs. Box 959, AMER. MACH.

Experienced designer of pumping machinery, reciprocating and centrifugal. Box 912, AMERICAN MACHINIST.

Draftsman; mechanical; (22); wishes position; 3 years' shop; 3 years' drawing. Box 945, AMERICAN MACHINIST.

Superintendent; mechanical and technical training; 7 years' executive experience, desires position with live interests. Box 958, AMERICAN MACHINIST.

Superintendent of well known concern desires change; good mechanic and executive; has made others and can make your plant pay. Box 917, AMERICAN MACHINIST.

First-class mechanical draftsman; German; 27, with 8 years' experience on general machinery; desires to change; initial salary, $22. Box 943, AMERICAN MACHINIST.

Practical mechanic; technical and business training, with iniative and capacity; 17 years' executive experience, wants position as factory superintendent. Box 924, AM. M.

Superintendent; age 37; wide experience on interchangeable work, special machinery and metal specialties; executive ability and excellent manager of men. Address Box 802, AMERICAN MACHINIST.

PENNSYLVANIA

Responsible position by member A. S. M. E. who has successfully filled positions of machinist, foreman tool department having charge of over 1000 machines, draftsman, designer of special machinery, and superintendent; superintendent of one concern ten years, at present holds position as superintendent. Box 954, AMERICAN MACHINIST.

RHODE ISLAND

Designing draftsman, wants to change; experience in fixtures, jigs and automatic tool machinery for duplicating work. Box 940, AMERICAN MACHINIST.

WEST OF MISSISSIPPI

To correspond with parties wanting up to date instructor in machine shop, forge and foundry practice. Box 923, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Superintendent to take charge of small hardware manufacturing plant, capable of developing into a very large industry; must be a worker, good handler of men and capable of designing tools to produce goods at lowest possible cost; opportunity for ambitious worker. Address, stating salary wanted, to "Canada," AMERICAN MACHINIST.

CALIFORNIA

Wanted—Instructor in mechanical engineering for university work; technical graduate with some experience. Box 944, AM. MACH.

CONNECTICUT

Wanted—First-class all-round machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Machinist wanted to superintend a machine room of 30 men in manufacturing establishment; must be broad-gauge, manly, a good mechanic, and not over 40 years old; executive ability necessary, with a thorough knowledge of designing and constructing new work as well as repairing; a good salary and permanent job for the right man. Write, stating references to C. D. Morris, R. Wallace & Sons Mfg. Co., Wallingford, Conn.

GEORGIA

Wanted—Machinists to work in one of the best shops in Atlanta; good places for good men; open shop. E. Van Winkle Gin & Machine Works, Atlanta, Ga.

ILLINOIS

Wanted—Educated and experienced machine-tool expert in manufacture of gas engines. Ability to handle men to produce best quality goods upon most economical basis. Location near Buffalo. Box 880, AM. MACH.

MASSACHUSETTS

Metal pattern maker wanted; steady work; no labor troubles. Box 951, AMER. MACH.

First-class draftsmen and tracers; good checkers, and men with experience in designing small and medium size machine tools, preferred; location, vicinity of Boston. Box 939, AMERICAN MACHINIST.

MEXICO

Wanted—Machine shop foreman for shop employing about thirty men; must have experience on mining machinery and be able to work native help; must be strictly sober and be able to give results; best of climate. Address Compania Industrial Mexicana, P. O. Box 49, Chihuahua, Mexico.

MICHIGAN

Machinists Wanted—First-class machine hands and floor hands on heavy work; steady employment assured. Northern Engineering Works, Detroit, Mich.

Wanted—By an established Michigan gasolene engine manufacturer an experienced draftsman and designer to take full charge of drafting department; applicant must be up to date in factory details, and a hustler to such a permanent position is offered; state age, married or single, reference and salary expected; communications treated confidentially. Box 915, AMER. MACHINIST.

Mechanical superintendent for machine shop doing contract work on small parts and employing two hundred men; must be a thoroughly capable mechanic and have had several years' experience in handling the men;

must be able to design jigs and tools for rapid production of duplicate work and able to give references as to ability and character; all communications confidential. Box 949, AMERICAN MACHINIST.

MINNESOTA

Foreman machinist, experienced upon high speed machinery; under 45; with executive ability; new enlarged works; state experience, wages and references. Box 96, AMER. MACH.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

Wanted—A first-class nickel plater; one who understands buffing and polishing; by manufacturing concern who do their own nickel plating; must thoroughly understand the art; steady employment guaranteed to right party Address Box 950, AM. MACH.

Draftsman Wanted — Large lead mining company, 65 miles south of St. Louis, Missouri, wants draftsman for mechanical drafting and for making surface and underground maps; must be first-class freehand letterer and neat workman; man with knowledge of plotting and calculating survey field notes preferred; applicants please submit specimens of work and state salary wanted. Box 867, AMERICAN MACHINIST.

Gas engine works, making engines from 1½ to 20 h.p., established 1894, has opening for first-class, up-to-date man, capable of superintending plant and reducing cost of production to minimum; one only who has had practical business experience and will take an active interest and invest a reasonable amount of his own money need reply; engine is fully developed, very simple and easily manufactured. Box 952, AM. MACH.

NEW JERSEY

Wanted—Tool, die and instrument makers accustomed to accurate complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—A competent traveling salesman on fan and motor business; must understand direct-current motors and special motor application; a good position for the right man; answer by letter, state experience and give references. The Eck Dynamo and Motor Company, Belleville, New Jersey.

NEW YORK

Wanted — Experienced draftsman, toolmakers and machinists; give age, references and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Competent operators for milling machines, boring mills, Jones & Lamson and other turret machines on automobile work. The Lozier Motor Co., Plattsburg, N. Y.

Manager wanted for large factory located in England; must have successful practical experience in the manufacture of small tools, including high-speed twist drills of the highest grade; also thorough technical and general education and some commercial and executive experience; permanent position and good salary. Apply by letter stating age and experience. Box 911, AMERICAN MACHINIST.

Wanted—Assistant foreman over a machine room of about thirty men (engine lathes, turret lathes, drill presses, shaper, milling machines and vise work) in a manufacturing establishment in New Jersey about fifteen miles from New York; applicant must not be over forty years old, of good executive ability, a first-class mechanic, and must know how to lay out work to advantage; a good and permanent position to a bright, energetic and bustling man. Address, giving reference and salary expected. Box 953, AMERICAN MACHINIST.

OHIO

Wanted—One machinist experienced on a 3-A heavy Brown & Sharpe Universal Milling Machine. State wages expected and experience. Leidecker Tool Co., Marietta, O.

Head draftsman for a Cincinnati machine tool shop of 100 hands; one with experience on radials and turret machinery preferred; state experience and salary. Address Box 913, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class machinists, floor and machine hands. Bury Compressor Co., Erie, Pa.

Wanted—Machinists, fitters and machine hands; desirable class of machine tool work. Colburn Machine Tool Co., Franklin, Pa.

On account of increase of plant, we want molders, lathe, planer and floor hands; good pay and steady work to good men. Address or apply Ridgway Machine Company, Ridgway, Pa.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA

Wanted—First-class toolmakers for small jig and die work; also machinists accustomed to small work. Apply by letter or personally, American Telegraphone Co., 57 18th Street, Wheeling, W. Va.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

For Sale

Test Indicators. H. A. Lowe, Cleveland, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

For Sale—Boilers; battery of two 150 h.p. Babcock and Wilcox water tube boilers, for 100 pounds pressure; first-class condition; complete, all trimmings. Nathan Manufacturing Co., 416 East 106th St., New York City.

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Cortland Cor. Wheel Co., Cortland, N. Y.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

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Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Butterfield & Co., Derby Line, Vt.
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Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arches, Boiler Door

McLeod & Henry Co., Troy, N. Y.

Architects

Podge & Day, Philadelphia, Pa.

Barrels, Steel

Cleveland Wire Spring Co., Cleveland, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Baird Machine Co., Oakville, Ct.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
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Hoggson & Pettis Mfg. Co., New Haven, Conn.

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Belt Filler

Rhoads & Sons, J. E., Phila., Pa.
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belting, Leather

Main Belting Co., Phila., Pa.
Rhoads & Sons, J. E., Phila., Pa.
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Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machinery, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Bending Machinery, Power

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blanks, Nut and Screw

Dyson & Sons, Jos., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

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Blowers

American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.
Soltmann, E. G., New York.

Blue Print Paper

Soltmann, E. G., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Boiler Setting

McLeod & Henry Co., Troy, N. Y.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown & Co., H. B., East Hampton, Conn.

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Detrick & Harvey Mach. Co., Baltimore, Md.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Machinery Co., Bowling Green, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang Co., G. R., Meadville, Pa.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, Ohio.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case-Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.
Piers, Frank, Philadelphia, Pa.
Sames, C. M., Jersey City, N. J.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Kern Machine Tool Co., Cincinnati, Ohio.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Nies-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes, Tote

Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Brazing

Reinforced Brazing & Machine Co., Pittsburg, Pa.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

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Case-Hardening

Rogers & Hubbard Co., Middletown, Conn.

Cast Iron Brazing

Reinforced Brazing & Mach. Co., Pittsburg, Pa.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings Steel

Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach Co., D. E., New London, Conn.

Centers, Planer

Bartlett, E. E., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold

Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Bartlett, E. E., Boston, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction

American Tool & Machine Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio

Collectors, Pneumatic

Sturtevant Co., B. F., Hyde Park, Mass.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compound, Cutting

New York Lubricating Oil Co., New York.

Compound, Slushing

Warren Bros. Co., Boston, Mass.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Machine Co., Boston, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Link-Belt Co., Philadelphia, Pa.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Corundum

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Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery

Veeder Mfg. Co., Hartford, Ct.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Fdry. Prov., R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Brown Hoisting Mach. Co., Cleveland, Ohio.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Phila., Pa.

Crank Shafts

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, Ohio.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.

Cutters, Milling—*Continued.*

Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers

Veeder Mfg. Co., Hartford, Ct.

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American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York City.
Safety Emery Wheel Co., Springfield, Ohio.

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Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, oCnn.

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Economy Drawing Table Co., Toledo, Ohio.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

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Mittineague Paper Co., Mittineague, Mass.
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Technical Supply Co., Scranton, Pa.

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Universal Drafting Mach. Co., Cleveland, O.

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Goodell-Pratt Co., Greenfield, Mass.
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Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

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American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Marshall & Huschart Machry. Co., Chicago, Ill.
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Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

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Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

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Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Husschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Radial—*Continued.*

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Vandyck Churchill Co., New York.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
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Patterson, Gottfried & Hunter, Ltd., New York.
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Wiley & Russell Mfg. Co., Greenfield, Mass.

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Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

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Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
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U. S. Electrical Tool Co., Cincinnati, O.

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Chisholm & Moore Mfg. Co., Cleveland, O.
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Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

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Electric Controller & Supply Co., Cleveland, O.
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Crocker-Wheeler Co., Ampere, N. J.
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Backus Water Motor Co., Newark, N. J.
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Struthers-Wells Co., Warren, Pa.

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Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

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Gorton Mach. Co., Geo., Racine, Wis.

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Exhibition Machinery
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Philadelphia Bourse, Phila., Pa.

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Nicholson & Co., W. H., Wilkes-Barre, Pa.

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Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
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Filing Machines
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Page-Storms Drop Forge Co., Springfield, Mass.
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Forgings, Hydraulic
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Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
Baldwin Steel Co., New York.
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Heppenstall Forge & Knife Co., Pittsburg, Pa.
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Furnaces, Gas
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Furnaces, Melting
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Pratt & Whitney Co., Hartford, Conn.
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Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

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Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
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Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Taylor-Wilson Mfg. Co., McKees Rocks, Pa.

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Chicago Raw Hide Mfg. Co., Chicago, Ill.
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Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
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Philadelphia Gear Works, Philadelphia, Pa.
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Albro-Clem Elevator Co., Philadelphia, Pa.
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Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
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Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cutter—*Continued.*
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.

Grinders, Saw
Tindel-Morris Co., Eddystone, Pa.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding and Polishing Machinery
Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burke Machry. Co., Cleveland, O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Gardner Mach. Co., Beloit, Wis.
Goodell-Pratt Co., Greenfield, Mass.
Graham Mfg. Co., Prov., R. I.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Wells Sons Co., F. E., Greenfield, Mass.

Grinding Wheels
Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Cortland Cor. Wheel Co., Cortland, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Corundum Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Cleveland Stone Co., The, Cleveland, O.
Niles-Bement-Pond Co., New York.
Pike Mfg. Co., Pike, N. H.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Pneumatic —*Cont*
Sampson & Co., Geo. H., Boston, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Hammers, Power
Beaudry & Co., Inc., Boston, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Erie Foundry Co., Erie, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Cincinnati Ball Crane Co., Cincinnati, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Hangers, Shafting
Link-Belt Co., Philadelphia, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hobbing Machines, Worm
Gould & Eberhardt, Newark, N. J.
Grant-Lees Mach. Co., Cleveland, Ohio.
Pratt & Whitney Co., Hartford, Conn.

Hoisting and Conveying Machinery
Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric
C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hobbs, Clinton E., Boston, Mass.

Spiral Gearing by the Hindley Process

The Hindley Principle Extended to Cover Gears of Low Speed Ratio with Large Increase in Area of Contact

EDITORIAL CORRESPONDENCE

The essential difference between worm gearing and spiral gearing lies primarily in their method of manufacture. A worm is commonly cut in the lathe and a worm wheel is commonly hobbed, whereas both members of a pair of spiral gears are cut in the milling machine. Most worms have a moderate pitch and under these circumstances it is easy to make them in a lathe, especially if the worm has but one or at most but few threads. As the pitch, and with it the pitch angle, is increased, the number of threads is also increased, and the time soon comes when, partly because of the difficulty of cutting steep-pitch screws in the lathe and partly because that machine provides no means for accurately dividing the pitch by the number of threads, it becomes unsuitable for making worms. Under these circumstances the work is transferred to a milling machine, and the result is a spiral gear.

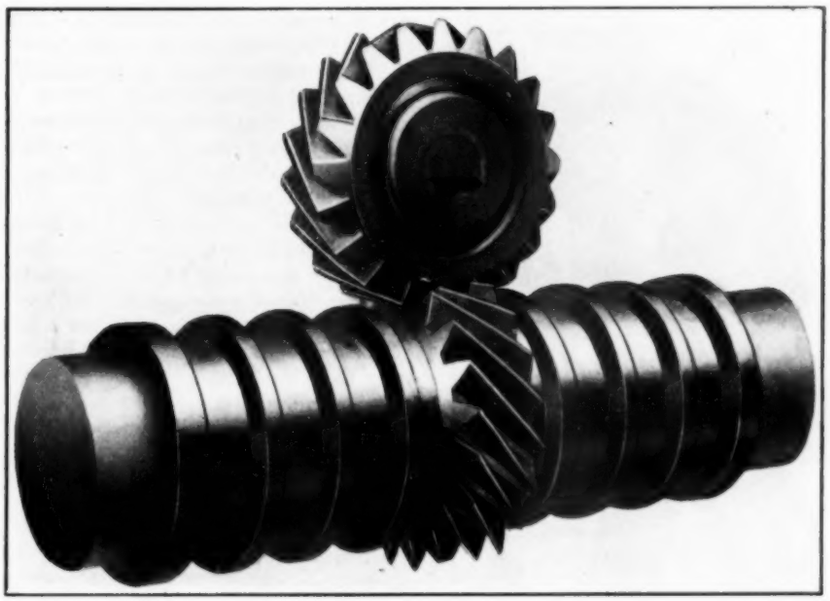


FIG. 1. HINDLEY SPIRAL GEARS RATIO 1 TO 1

Analogy Between Worm Gears and Spiral Gears

The analogy between the worm wheel and the corresponding spiral gear is obvious at a glance, as they do not differ widely in appearance; but the analogy between the worm and the corresponding spiral gear is less obvious and may easily be overlooked entirely. The spiral gear which corresponds with the worm is, however, nothing else than a worm with many threads of steep pitch, the pitch being commonly so steep that each tooth makes but a small part of a complete turn around the gear, whereas with worms the steepness of the pitch is so small that each thread commonly encircles the worm several times. The analogy between the worm and the corresponding spiral gear becomes still more obscure when, as in many cases, the gear becomes of considerable size and may even be larger than its mate, whereas the reverse is always true with worms.

While the analogy between the worm wheel and the corresponding spiral gear is more obvious in appearance than that between the other gear and the worm, the difference is really greatest in the case in which it appears to be least. With properly shaped cutters there is no reason why the shape of the teeth of the driving member, or worm, should not be the same as though cut in the lathe, whereas the teeth of the other gear are necessarily quite different from those cut with a hob. The net result is that while in a geometrical sense there is no difference in the action between a worm and its gear and that between a pair of spiral gears, there is in a mechanical sense a wide difference. The cutting of a worm gear by means of a hob, which is essentially a duplicate of the worm, results in a closeness and kind of contact which is impossible with spiral gears. Just what the contact between a worm and worm wheel is has been the subject of much dispute, but it is at least clear that the contact between the teeth of a pair of spiral gears is point contact only, and that it is very much less intimate than that between the teeth of a worm and its mating gear.

FIG. 2. HINDLEY SPIRAL GEARS RATIO 2 TO 1

Improvement of Contact Greater in Spiral than in Worm Gears

The Hindley worm gears made by Morse, Williams & Co. are familiar to our readers, and the object of this article is to point out an extension by them to spiral gears of the Hindley method of making worm gears. The result is a contact between the two gears of a pair which is exactly the same as that existing in a Hindley worm and gear, and because the area of contact in spiral gears of the usual construction is much smaller than in worm gears of the usual construction, it follows that the increased area obtained in the Hindley as compared with the common spiral gears is much greater than that obtained in the Hindley as compared with the common form of worm gears.

Examples of the New Gears

The accompanying illustrations show some interesting examples of the new gears. Fig. 1 shows a gear employed in the new dynamometer car of the Pennsylvania Railroad. The speed ratio is 1 to 1. Fig. 2 shows in two views gears with a ratio of 2 to 1, and the fact that these gears differ from Hindley worms only in degree is much more obvious in this figure than in Fig. 1. The concave form of tooth which is characteristic of

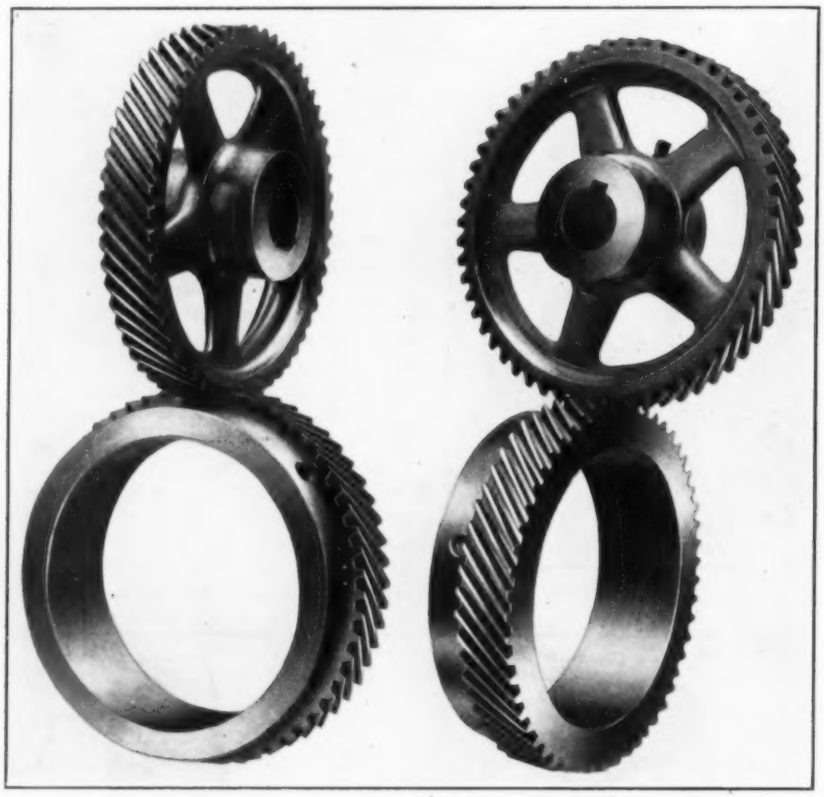


FIG. 3. HINDLEY SPIRAL GEARS RATIO 1 TO 1

With the Hindley principle applied to spiral gears, all distinction between worm and spiral gears, except one of degree, disappears and the distinction in name as now used by Morse, Williams & Co. is based entirely on this difference of degree. The increase of pitch in the driving member, beyond what can be produced in the lathe, is made in order to obtain a smaller speed ratio than is possible with worm gearing, and the distinction in name is based upon an arbitrary division in the ratio—those gears in which the ratio is above 10 being called worm gears and those in which the ratio is less than 10 being called spiral gears.

The new gears are cut essentially as are Hindley worm gears—the member corresponding to the worm with a revolving cutter head and the member corresponding to the worm gear with a hob, although at the low speed ratios employed the hobs assume most curious and almost unrecognizable forms.

hobbed gears is apparent at a glance, and it requires no great stretch of the imagination to recognize that the lower or driving member is a worm of many threads and steep pitch. Fig. 3 shows in two views another and larger example, in which again the ratio of speed is 1 to 1.

The gears shown in Fig. 1 have been tested for efficiency, and when carrying 5½ horse-power gave an efficiency of 87 per cent.; when carrying 8⅓ horse-power, 78 per cent. The wheel has a pitch diameter of 9 5/32 inches, with 20 teeth of 1 7/16 inches pitch, the worm having the same pitch diameter with 20 threads of 28¾ lead.

The gears shown in Fig. 2 are of 30-35 carbon steel and are hardened. The wheel has a pitch diameter of 8.355 inches, with 28 teeth of 15/16 inch pitch. The worm has a pitch diameter of 8.8325 inches with 14 threads of 13⅛ inches lead.

F. A. H.

Some Old Turbine Water Wheels

By Lewis F. Moody

While taking a vacation ramble last summer the writer "discovered" an old mill at Scantic, near East Windsor, Conn., which on examination was found to contain some wooden water wheels of the turbine type. While this type of water wheel may not have been extremely rare in early times in New England, still we are accustomed to think of the modern turbine as the product entirely of European science, and to imagine that its introduction and development in America are of comparatively recent date. There is ample justification, however, for considering the present turbine to be a development of the primitive "tub" wheels, such as those about to be described.

The mill in question is an old frame building now standing silent and deserted, except for the ducks which occasionally visit the placid waters of the tail-race. The mill in its active days utilized a fall of about five feet created in the Scantic river (which is little more than a creek) by a log dam of crib construction.

Among the ruins of the interior of the mill are the turbine wheels. There are three wheels, all with vertical shafts, which once drove the millstones and other machinery through various systems of transmission, ranging from cast gearing to worm gears carved out of solid wooden blocks, and including manila-rope drives, cotton belts running on solid wooden pulleys, and wooden pin-gearing.

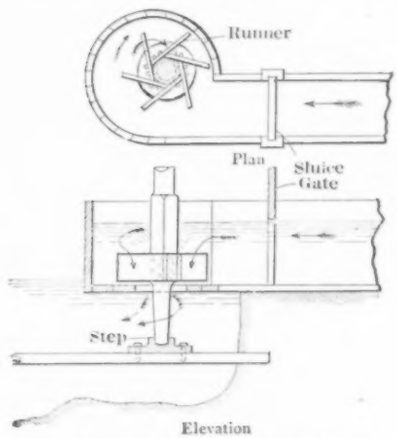
The casings of the three wheels consist of cylinders set eccentric with the turbine shafts and formed of wooden staves placed vertically. The sides of the casings are continuous with the rectangular intakes, which are sluices, open at the top, and set off the center lines of the casings. Each casing has a wooden bottom, in which a round hole is cut for the wheel. The top is open and the sides extend above the head-water level. A wooden gate in the intake sluice regulates the admission of water to the wheel. Two of the wheels consist of large wooden hubs with curved cast-iron vanes bolted around them, and iron rings surrounding these, forming true "Jonval" runners. The hole in the bottom of the casing is of the same diameter as the outside of the runner.

There are no guide vanes of any kind on any of the wheels, the "volute" casings evidently having been considered sufficient to give the water the proper whirling motion before it entered the runners. One wheel has an iron shaft; two of the wheels have cast-iron bevel gears; with

the exception of the wheel vanes mentioned, everything else is of wood—the shafts of two of the wheels, the countershafts and pin-gearing, and the wheel vanes of the third runner.

The writer was informed by one of the oldest residents of the locality that two of the wheels are "new," having been rebuilt only about 50 years ago, but that the third is probably as old as the mill. In this turbine the hole in the bottom of the casing is eccentric with the outside as in the other wheels, but is smaller than the circumference of the runner blades, which are simply wooden paddles, six in number, designed to revolve in the space above the bottom of the casing. The circumference of the paddles nearly touches the wall of the casing at the narrowest part. The paddles are perfectly flat, and are fastened to a hexagonal enlargement of the shaft. The accompanying illustration shows the arrangement of one of the sluice boxes and wheel.

The crude, but effective, engineering



OLD WOODEN TURBINE AT OSBORNE'S MILL, EAST WINDSOR, CONN.

skill displayed in the construction of these wheels led the writer to look up the history of the mill and to add the following extracts from the manuscript of a "History of East Windsor," by Lemuel Stoughton, now in possession of his family.

Osborne's Mill

"Moses Osborne was one much respected by his acquaintances and ran the saw and grist mill from my earliest recollection to his death, the date of which I cannot now name. His mill during his life was a place of much business, a large amount of sawing and grain grinding. Besides an extensive common custom, a good deal was done for the Warehouse Point distilleries, and the water of Scantic was kept at turning wheels pretty constantly all the year round. It then had no equal anywhere near, though in later years a mill on Broad brook has taken the custom of that region. But for water power its equal is not now in this region. It was first built in 1728 . . . and Joseph Harper was the master builder.

"In addition to the business above named at this mill, wool carding was done in the loft by Mr. Osborne and the long, slim rolls were produced for the family spinning wheel, two of the first processes toward cloth-making for men and boys, women and girls, to some extent.

"Then away to Dry Brook, where now is Rockville's saw and cider mill, the cloth must go to be dressed, colored and pulled ready for—not often the tailor—but the tailoress. And hence came most of the family apparel before factories and woolen and cotton mills came to be built, which has made one of the great changes of the country.

"This establishment becomes of historical consequence on account of its long-time usefulness and necessity to the surrounding inhabitants. No place about old East Windsor became more widely known than Osborne's mill."

Size Differences of Bolts and Nuts for "V" and Standard Threads

By George R. Moore*

The writer has felt the need of a table giving size differences of bolts and nuts for "V" and standard threads, and has worked up the following:

MOORE'S TABLE OF SIZE DIFFERENCES OF BOLTS AND NUTS FOR "V" AND STANDARD THREADS

I No. Threads to 1 in.	Size of Bolt or Pipe.	II Depth of Thread Constant.	III Nearest 64th.	IV $D_1 - D_2$ or Dif.
1		.866	55/64 = .859	1 47/64
2		.433	28/64 = .437	7/8
3	3 1/2 to 4	.288	18/64 = .281	9/16
4	3 to 3 1/4	.216	14/64 = .218	7/16
5	1 3/4 to 1 7/8	.173	11/64 = .171	11/32
6	1 3/8 to 1 1/2	.144	9/64 = .140	9/32
7	1 1/8 to 1 1/4	.124	8/64 = .125	1/4
8	1 and pipe, 2 1/2 and up	.108	7/64 = .109	7/32
9	7/8	.096	6/64 = .093	3/16
10	3/4	.087	5/64 = .078	11/64
11	5/8	.079	5/64 = .078	5/32
11½	1 to 2 pipe	.075	5/64 = .078	5/32
12	1/2 and 9/16	.072	5/64 = .078	5/32
13	1/2 (Foreign)	.066	4/64 = .062	9/64
14	7/16 and 1/2 to 3/4 pipe	.062	4/64 = .062	1/8
15		.058	4/64 = .062	1/8
16	3/8	.054	4/64 = .062	7/64
17		.051	3/64 = .046	7/64
18	5/16 and 1/4 to 3/8 pipe	.048	3/64 = .046	3/32
19		.046	3/64 = .046	3/32
20	1/4	.043	3/64 = .046	5/64
27	1/8 pipe	.032	2/64 = .031	1/16

RULE: 0.866 divided by Pitch × 2 = $D_1 - D_2$.
For U. S. or standard threads take ¾ ($D_1 - D_2$).
$D_1 - D_2$ for "V" thread = 1.732 divided by Pitch.
$D_1 - D_2$ for U. S. or standard thread = 1.299 divided by Pitch.

This table shows at a glance the difference in size of any bolt and nut based on the depth of the thread (number of threads to the inch), regardless of the diameter of either. Having a bolt of any diameter, for any given thread, subtract the difference given in the table for that thread (or if the difference wanted is not given, it can be found by the rule) and it will give the size to which the nut is to be punched, drilled or bored. Having the size of the nut, add the difference to get the size of the bolt. This difference allows for a full thread for both bolt and nut, to the nearest 64th of an inch. In all tables which the writer has seen this difference in size is based on the Standard or U. S. thread, or on a given (standard) sized bolt and a given number of threads to the inch for that size only; e.g., ¼-inch, 20 threads; ¾-inch, 10 threads; 2-inch, 3½ threads, etc., there being no table of sizes for the "V" thread, which is the one most commonly used. The further utility of such a table is shown when it is considered that the dimensions for such calculations are usually given in decimals, with which the average mechanic is not familiar; or, if he is, he will not take the time to reduce to a fraction of an inch the decimal given, but will make the hole in a ¾-inch nut (10 threads) 5/8-inch scant, or somewhere near 5/8-inch.

The difference given in the table is for "V" threads. For "Standard" threads, but three-fourths of this difference is to be considered. Such a table will be found useful wherever bolts and nuts are made or used, particularly in mathematical-instrument factories and other establishments, where a great many other than standard threads and sizes are used.

Mr. Sellers recommends making the holes in nuts of such a size as to allow for 85 per cent. of a full thread, the difference (about 12 per cent., or one-eighth) being made up by the crowding of the metal. This has been found to be a very good practice. This allowance (which would be about one-eighth of the difference given in the table), if used, must be added to the given difference and the hole in the nut be made that much larger, there being no allowance in the table for the crowding of the metal.

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Calculations Respecting Epicyclic Wheel Trains

Derivation of Formulas for Several Usual Types, and Extension of the Method of Analysis to a Somewhat Complex Epicyclic Train

BY FRANCIS J. BOSTOCK

This form of gearing, which is really that in which one gear revolves around the center of the one with which it is in contact, has received considerable attention of late, and one notices its use in several directions. We will therefore look into some of the calculations respecting it, leading from the simpler to the more complex.

SIMPLE PAIR OF GEARS IN FIXED BEARINGS

Example 1:

If in Fig. 1 R and N are two gears in mesh, r and n being their respective numbers of teeth, their bearings being fixed, then:

$$\frac{\textit{Velocity of drive}N\textit{ gear }N}{\textit{Velocity of drive}R\textit{ gear }R} = \frac{r}{n};$$

or, $N\text{'s velocity} = R\text{'s velocity} \times \frac{r}{n}$

If, however, R revolve in a positive direction, n must revolve in the opposite, that is, in a negative direction.

$$\therefore N\text{'s velocity} = -R\text{'s velocity} \times \frac{r}{n} \quad (1)$$

In all these calculations it is essential that great care be taken in order to obtain the correct sign of the resulting velocity.

GEARS IN FIXED BEARINGS, WITH AN IDLER

Example II.

An intermediate gear I is placed in contact with both N and R, Fig. 2. The effect will be that of giving N motion in the same direction as R.

$$\therefore N\text{'s velocity} = R\text{'s velocity} \times \frac{r}{n} \quad (2)$$

SIMPLE EPICYCLIC TRAIN

Example III.

Two gears, F and N, are in mesh, the centers of which are on the arm R, which is capable of revolving around the center of F. It is required to find the velocity ratio between R and N when R revolves around the fixed gear F; Fig. 3 shows the arrangement. The gear N is subject to two motions due to the following two conditions:

a. The fact of its being fixed to the arm R.

b. The fact that it is in contact with the gear F.

We will therefore in the first place suppose that they are not in gear, and that N cannot rotate on the arm R. Then if R makes one revolution around F it is obvious that N must also make one revolution around F, as in Fig. 4.

$\therefore$ *N's velocity, due to condition a* $= R\text{'s velocity}$,

the direction being the same as R's.

Secondly, if instead of R making one revolution around F in a + direction, we cause F to make one in the opposite, that is, negative direction, we shall have exactly the same effect. Therefore place F and N in mesh, and fix the arm R, as in Fig. 5.

Then if F makes -1 revolution, N will make $+\frac{f}{n}$ revolutions. (According to Equation 1.)

But -1 of $F = +1$ of R.

$\therefore$ 1 revolution of $R = \frac{f}{n}$ revolutions of N,

or *N's velocity, due to condition* $b = \frac{f}{n}$ *R's velocity.*

By addition we obtain the total impulses given to N, that is:

$$N\text{'s velocity} = R\text{'s velocity} + \frac{f}{n}\ R\text{'s velocity}$$

$$= R\text{'s velocity}\left(1 + \frac{f}{n}\right). \quad (3)$$

EPICYCLIC TRAIN WITH AN IDLER

Example IV.

If an intermediate gear I be inserted between F and N, as in Fig. 6, we have a similar case to the above, but the intermediate gear has the effect of changing the direction of revolution of N (Equation 2), due to its contact with F through I.

$$\therefore N\text{'s velocity} = R\text{'s velocity} \times \left(1 - \frac{f}{n}\right). \quad (4)$$

It will be seen that if $f = n$, N will not have any motion of rotation at all; and it will have a positive one if $f < n$ and negative if $f > n$. Thus by the adjustment of f and n one can obtain great reduction in speed by means of few moving parts.

SIMPLE EPICYCLIC TRAIN WITH INTERNAL GEAR

Example V.

Instead of the driven gear N being external, it might have been internal, as shown in Fig. 7. The effect will be the same as inserting an intermediate gear in Example III, giving the same result as Case IV, namely:

$$N\text{'s velocity} = R\text{'s velocity} \times \left(1 - \frac{f}{n}\right). \quad (5)$$

In this case $n > f$.

$\therefore$ The final direction is always +.

INTERNAL GEAR EPICYCLIC TRAIN WITH INTERMEDIATE GEAR

Example VI.

Fig. 8 shows a still further modification of this condition, I being an intermediate gear. The result is:

$$N\text{'s velocity} = R\text{'s velocity} \times \left(1 + \frac{f}{n}\right). \quad (6)$$

THE SAME TRAIN WITH THE INTERNAL GEAR DRIVING

Example VII.

With the above type, one often arranges the outer internal gear to be the driver, imparting motion to the arm carrying the intermediate gear. See Fig. 9.

We have seen by Equation 6 that:

$$\frac{N\text{'s velocity (driven)}}{R\text{'s velocity (driver)}} = \frac{1}{1 + \frac{f}{n}}.$$

$$\therefore N\text{'s velocity} = R\text{'s velocity} \div \left(1 - \frac{f}{r}\right)$$

$$= R\text{'s velocity} \times \left(\frac{r}{r+f}\right) \quad (7)$$

The latter two examples constitute what is known as the "Sun and Planet" gear, which is largely used in many mechanisms. All the above examples show "simple" gearing, but they can be compounded with great advantage.

COMPOUNDED GEARS IN FIXED BEARINGS

Example VIII.

Gears compounded together are shown in Figs. 10 and 11, 11 being a diagram of 10. One repeats the well known rule that:

$$\frac{\textit{Velocity of driven gear}}{\textit{Velocity of driver gear}} = \frac{\textit{Product of number of teeth of driver gears}}{\textit{Product of number of teeth of driven gears}}$$

or, $N\text{'s velocity} = R\text{'s velocity} \times \frac{r \times m}{s \times n}$ (8)

The direction is the same as N's namely, +.

COMPOUND EPICYCLIC TRAIN, WITHOUT INTERNAL GEAR

Example IX.

We will now arrange to fix one of the gears F, and by means of the arm R revolve the others around it, thereby causing N to revolve as shown in Figs. 12 and 13. As before, we will assume the gears M and S to be out of mesh, so that when the arm R, carrying with it the gear N, makes one revolution around F, N must also make one revolution relatively to F. Also when they are in mesh, the arm R being fixed and F makes one revolution in a negative direction (see Fig. 13). N will make $-\frac{f\,m}{s\,n}$ revolutions (Equation 8).

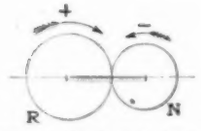


FIG. 1. Simple Pair of Gears in Fixed Bearings.
Eq. 1. N's V. = −R's V. x $\frac{r}{n}$

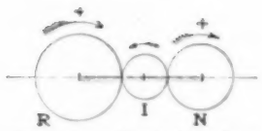


FIG. 2. Gears in Fixed Bearings, with an Idler.
Eq. 2. N's V. = R's V. x $\frac{r}{n}$

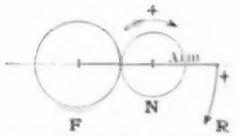


FIG. 3. Simple Epicyclic Train.
Eq. 3. N's V. = R's V. x $(1+\frac{r}{n})$

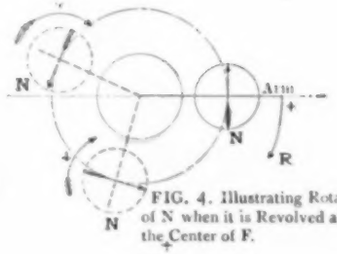


FIG. 4. Illustrating Rotation of N when it is Revolved about the Center of F.

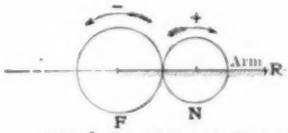


FIG. 5. Second Stage in Deriving Equation 3; Arm assumed to be fixed, F turned backward.

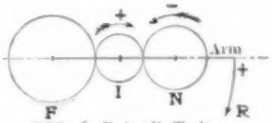


FIG. 6. Epicyclic Train with an Idler.
Eq. 4. N's Velocity = R's Velocity x $(1-\frac{r}{n})$

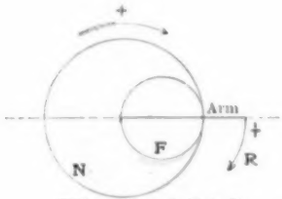


FIG. 7. Simple Epicyclic Train with Internal Gear.
Eq. 5. N's Velocity = R's Velocity x $(1-\frac{r}{n})$

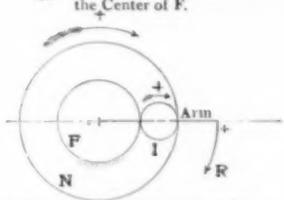


FIG. 8. Internal Gear Train with Intermediate Gear: the Arm Driving.
Eq. 6. N's Velocity = R's Velocity x $(1+\frac{r}{n})$

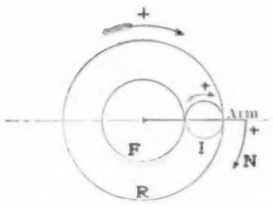


FIG. 9. Same Train as Fig. 8 but with the Internal Gear Driving.
Eq. 7. N's V. = R's V. x $(\frac{r}{r+f})$

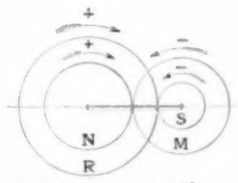


FIG. 10. Compounded Gears in Fixed Bearings.
Eq. 8. N's V. = R's V. x $\frac{rm}{sn}$

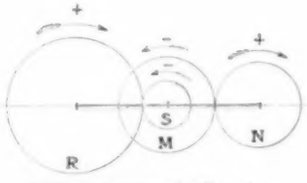


FIG. 11. Compounded Gears in Fixed Bearings.
See Equation 8, Fig. 10.

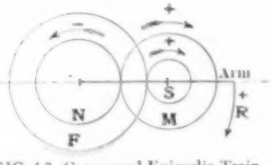


FIG. 12. Compound Epicyclic Train.
Eq. 9. N's V. = R's V. x $(1-\frac{rm}{sn})$

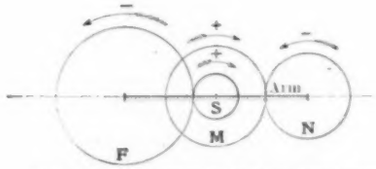


FIG. 13. Second Stage in Deriving Equation 9; Arm assumed to be fixed, F turned backward.

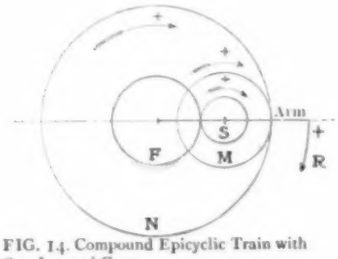


FIG. 14. Compound Epicyclic Train with One Internal Gear.
Eq. 10. N's V. = R's V. x $(1+\frac{rm}{sn})$

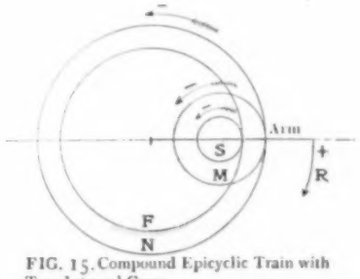


FIG. 15. Compound Epicyclic Train with Two Internal Gears.
See Eq. 9, same as Fig. 12.

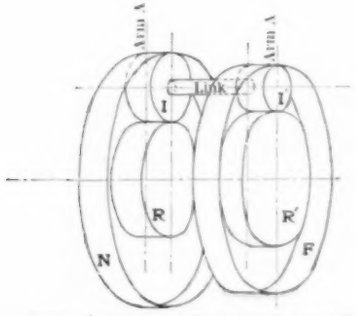


FIG. 16. An Epicylic Train Consisting of Two Central Gears, One Arm carrying Two Planetary Gears, and Two Internal Gears, One of which is Fixed.

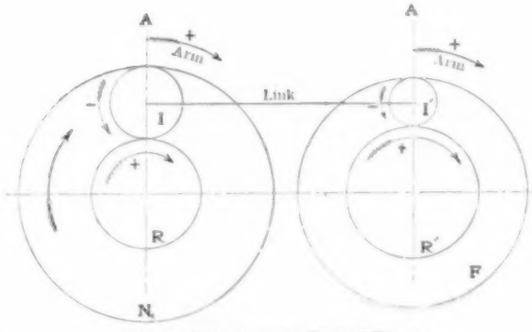


FIG. 17. Diagram of the Train of Fig. 16.
Eq. 11. N's V. = R's V. x $(\frac{rn-rf}{sn+rn})$

NOTATION

R—Denotes Driving Gear, or, in some cases, Arm.
r—Number of Teeth in Driving Gear.
N—Denotes Driven Gear or Arm.
n—Number of Teeth in Driven Gear.
I, S and M denote Intermediate Gears.
F—Denotes Fixed Gear.
f—Number of Teeth in it.
V—Angular Velocity.
——Denotes part which is Fixed.

Now the total motion imparted to N must be the sum of these two, namely:

$$1 \text{ revolution of } R = 1 - \frac{f\,m}{s\,n} \text{ revolutions of } N,$$

or, $$N\text{'s velocity} = R\text{'s velocity} \times \left(1 - \frac{f \times m}{s \times n}\right). \quad (9)$$

Compound Epicyclic Train with One Internal Gear

Example X.

Fig. 14 shows a slight modification of the last case, N being an internal instead of an external gear. Obviously the only difference will be in the direction of N's motion, that is:

$$N\text{'s velocity} = R\text{'s velocity} \times \left(1 + \frac{f\,m}{s\,n}\right). \quad (10)$$

Compound Epicyclic Train with Two Internal Gears

Example XI.

A further modification, however, is one in which both F and N are internal gears, Fig. 15, the effect of such being a change of sign in the equation.

$$\therefore \quad N\text{'s velocity} = R\text{'s velocity} \times \left(1 - \frac{f\,m}{s\,n}\right). \quad (9)$$

The type shown in Figs. 12 and 15 is, perhaps, one of the best methods of obtaining a good reduction of speed in an easy and cheap manner.

There are several combinations of the examples shown, but as they are all somewhat similar we will take another typical case as a guide for future calculations.

An Epicyclic Train Consisting of Two Central Gears, One Arm Carrying Two Planetary Gears, and Two Internal Gears, One of Which Is Fixed

Example XII.

The writer has successfully used the arrangement shown in Figs. 16 and 17, in which R and R' are two spur gears mounted on one shaft; I and I' are two "planet" pinions, while F and N are two internal gears, the former being fixed. R and R' are made to revolve, which has the effect of giving N a very slow speed.

A Scheme for Finding the Velocity Ratio

As this is somewhat complicated, we will work it out in stages:

1. Obtain the revolutions of the arm A when R' makes one revolution, F, of course, being fixed.
2. Obtain N's revolutions when the arm A is fixed and R makes one revolution.
3. Assume R fixed, and that the arm makes one revolution; obtain, then, N's revolutions.
4. Then if N makes so many revolutions to one of the arm, as given by stage 3, we can by proportion obtain how many will be caused by the amount given by Stage 1.
5. Add the results of 2 and 4 together, and obtain the motion given to N by one revolution of R, which is the desired result.

The Scheme Worked Out

Working the above out we obtain:

1. When F is fixed and R' makes one revolution, the arm A must make $+\frac{r'}{r'+f}$. (According to Equation 7.)
2. R makes one revolution, arm A being fixed; then N must make $-\frac{r}{n}$ revolutions. (According to Equation 2. Negative sign used because of the internal gear.)
3. When R is fixed and arm A makes one revolution, N will make $+\left(1 + \frac{r}{n}\right)$ revolutions. (According to Equation 6.)
4. With one revolution of arm, N makes $1 + \frac{r}{n}$ revolutions, from Stage 3; $\therefore$ *with* $\frac{r'}{r'+f}$ revolutions of the arm, as derived in Stage 1, N will make $\left(1 + \frac{r}{n}\right) \times \left(\frac{r'}{r'+f}\right)$.
5. The aggregate is the sum of the effects derived in Stages 4 and 2, namely, to one of R, N makes:

$$\left(1 + \frac{r}{n}\right) \times \left(\frac{r'}{r'+f}\right) + \left(-\frac{r}{n}\right) = \frac{(n+r)\,r'}{n(r'+f)} - \frac{r}{n} = \frac{rr' + r'n - rr' - rf}{n(r'+f)} = \frac{r'n - rf}{n(r'+f)}.$$

The final direction of revolution of N will depend upon the relation which $r'n$ bears to rf; if the former be greater, then the direction will be positive (+), and *vice versa*. The formula for this combination is, then:

$$N\text{'s velocity} = R\text{'s velocity} \times \left(\frac{r'n - rf}{n(r'+f)}\right). \quad (11)$$

Some Numerical Examples in Epicyclic Gearing

In order to illustrate the above examples we will take one or two cases.

If in Example and Fig. 3, $f = 30$, $n = 25$, then to one revolution of R, N will make $\left(1 + \frac{f}{n}\right) = 1 + \frac{30}{25} = 2\ 1/5$ revolutions.

It will be obvious that with $f = n$, N would revolve at twice the speed of R.

In the type shown in Fig. 7, $f = 60$, $n = 65$.

then

$$\frac{\text{Velocity of } N}{\text{Velocity of } R} = \frac{1 - \frac{n}{n}}{1} = \frac{1 - \frac{60}{65}}{1} = \frac{5}{65} = \frac{1}{13}.$$

The arrangement of Fig. 12 is much used. Let $n = 60$, $f = 61$, $s = 40$, $m = 41$.

Then the velocity ratio between N and R is $1 - \frac{f\,m}{s\,n} : 1$

$$= 1 - \frac{61 \times 41}{40 \times 60} = 1 - \frac{2501}{2400}$$

= say 1:24, in a minus direction.

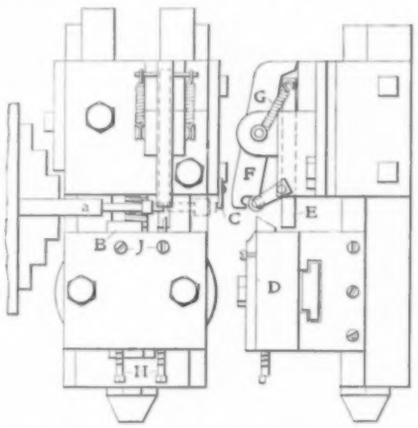
Illustrating Example XII, Fig. 16, let $r = 90$, $r' = 91$, $f = 120$, $n = 121$.

$$\frac{\text{Velocity of } N}{\text{Velocity of } R} = \frac{r'n - rf}{n(r'+f)} = \frac{91 \times 121 - 90 \times 120}{121\,(91 + 120)} = \frac{11{,}011 - 10{,}800}{121 \times 211} = \frac{211}{121 \times 211} = \frac{1}{121}.$$

Making Studs on the Lathe

By H. E. Short

In starting the stock A is brought forward about 3/8 inch past the left-hand cor-



MAKING STUDS ON THE ENGINE LATHE

ner of the tool B and reduced; then it is led forward until the shoulder almost touches the back rest F, when it is down to position. The next operation produces the finished article, except cutting off, the cut-off tool bringing the short end to length.

Backing the tools to just clear the work allows the back rest to rise so as to let the body of the stud pass, which is advanced to the stop C, gaging for the next operation in which the stud is cut off and another formed. The stop C is slightly adjustable, to allow the length of body to be quickly changed a little.

After once starting a rod, a finished piece is made in one operation and drops into a box.

The tools are mounted on the compound rest and the diameter is gaged by a stop for the cross-feed handle. To position the tools the compound rest is adjusted.

When the tools are advanced the tool holder D pushes rod E under the back

rest *F*, causing it to lower into correct position against the small portion of the work; the springs draw the rod back when the tools recede, allowing the back rest to rise again.

The tool holder is slotted so the tools will just fit nicely, having the screws *H* to set and back the tools. The screws *I* are to hold the tools down firmly.

Offset Cylinders in Gasolene Engines

By E. J. Bartlett

The modern quiet running, high-speed gasolene engine as applied to automobile service is the result of considerable study and experimentation, and on the whole is a credit to the industry. Although automobile engines at the present time are uniformly satisfactory, the details and refinements in their design are still undergoing improvements. One of the latest features to receive considerable attention is offsetting the center of the cylinder from that of the crank-shaft, or some similar construction, whereby the objectional side thrust on the piston is made approximately uniform during the widely varying pressures on the piston as it performs the different strokes.

This idea is not new, as at least one prominent American automobile manufacturer has actively advocated and practiced this construction for several years. Although good, the idea did not "catch on" to any great extent until last season, when some dozen or more American manufacturers adopted this construction. Several more are said to be incorporating it in their next season's designs.

Some designers accomplish their purpose by offsetting the wrist-pin in the piston, but the usual method is to offset the cylinder a certain percentage of the stroke. Some designers argue that this construction is not worth while, as it makes the engine unsymmetrical, but this objection, if it may be so called, is slight; and inasmuch as there are several real advantages to be attained, it will undoubtedly be adopted to quite an extent as the refining of the gasolene engine goes on. A technical discussion will best bring out the points to be considered.

The Varying Conditions

At the start it may be said that there are so many conditions influencing the operation of a gasolene engine, such as the timing of the spark, fuel, valve timing, etc., which are variable to quite an extent, that the designer cannot hope satisfactorily to fulfil them all; and, like many other engineering problems, a fair compromise for a given set of conditions is all he can hope to attain. He should therefore meet the average running conditions of his engine, as will be explained later.

Since the exigencies of the case in regard to length of engine and constructional costs, prohibit, or at least make impractical, the use of a crosshead, the piston must combine the strictly piston feature of holding the packing rings with that of the crosshead guiding feature. For these reasons the piston length must be sufficient to keep the variable side thrust, due to the angularity of the connecting rod, down to a practical pressure per square inch of projected area. If excessive pressure does occur the engine will be noisy and knock when the direction of the pressure is reversed. It will also result in leakage, since the piston rings cannot pack an oval cylinder. In the case of a horizontal engine the weight of the piston, wrist-pin and part of the connecting rod will also add a constant downward pressure. On the other hand, the piston must be as light as is practical, owing to the strains on the bearings due to its inertia. It must also be short, to reduce the length of the engine. It is therefore advisable to make the side pressure of the piston as uniform as possible throughout the entire cycle of operation.

The Side Thrust of Piston

The maximum side thrust of the piston per square inch of piston area is given by the maximum value of the formula $p = P \tan. \alpha$, where P is the explosive pressure per square inch on the piston and α the angle between the connecting-rod center and the axis of the cylinder. The value of tan. α is evidently the largest when the crank angle is 90 degrees, but at this point the pressure P is greatly reduced, as seen by the indicator diagram in Fig. 1. The maximum side thrust of the piston then occurs somewhere between this point and the end of the stroke, the exact location depending on the relation of the expanding line of the indicator card, the connecting-rod length and the throw of the crank, for every individual case.

To simplify the discussion we may safely neglect the variable and somewhat uncertain inertia effect, as it opposes the pressure on the piston. Also, for four-cycle engines, the compression and explosion strokes only need be considered, since they act under the greatest pressures and at opposite angles of the connecting-rod.

How It Works Out

For a concrete example assume an engine with a 4½-inch stroke, a connecting-rod 9 inches long, and operating under average conditions as represented by the indicator diagram shown in Fig. 1. The formula $p = P \tan. \alpha$ may then be applied to different points in the stroke, or

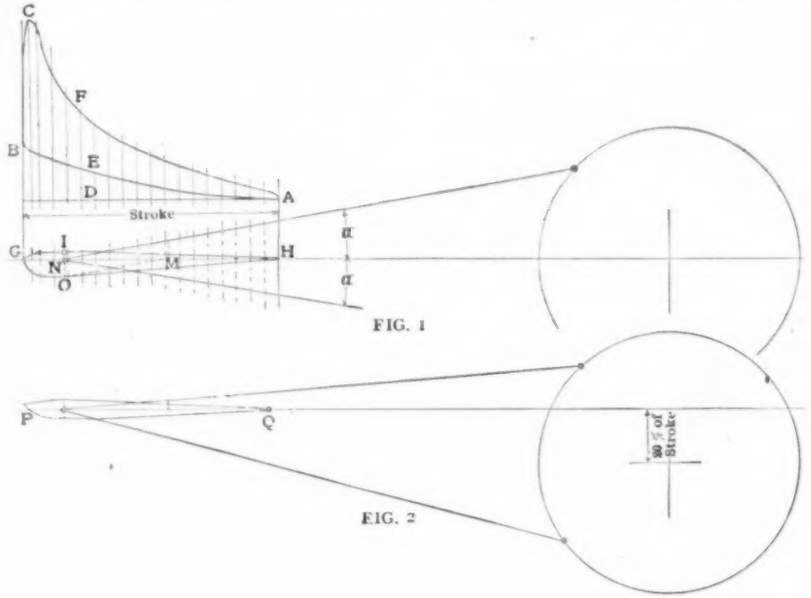


FIG. 1

FIG. 2

DIAGRAM SHOWING SIDE THRUST OF PISTON IN GASOLENE-ENGINE CYLINDERS

what is perhaps plainer, the side thrust of the piston at any point may be graphically determined by applying the rule of the parallelogram of forces.

In the diagram shown, the curve *B C A* represents the variations in pressure during the explosion or power stroke, and the curve *A B* represents the same for the compression stroke. It is now an easy matter to plot the curve representing the side thrust of the piston during any stroke, the accuracy of which depends only on the scale and care used in plotting it, or calculating the values if the formula is used.

Assume the wrist pin to be at the point *N* in the stroke, we find the position of the connecting-rod by taking *N* as a center and intersecting the crank-pin circle with a radius equal to the length of the connecting-rod. By laying off *N M* equal to *D F*, which represents the explosion pressure at this point in the stroke, we may

determine the length of the line $N O$ by completing the parallelogram as shown. The point O is one point in the curve representing the side thrust. In the same manner any number of other points may be found, thus determining the curve $G O H$. Since the angle α is the same but opposite, for a given position of the piston during the compression and power strokes, the line $D E$, representing the compression pressure for this point in the stroke, may be applied to the point N in the same manner as $D F$, but its component taken on the opposite side of the axis of the piston. The same method may be followed for the other points selected in the stroke and the results plotted, giving the curve $G I H$. These two side-thrust curves show that the maximum side pressure occurs during the explosion stroke and when the piston has traveled some 15 per cent. of its stroke; also that it is unequal during the two strokes, as would be expected.

Evening up the Pressure

As previously explained, this inequality is what we wish to avoid. This can be accomplished by offsetting the center of the cylinder from that of the crank-shaft so that the angle of the connecting-rod is unequal during the two strokes, the smaller compression pressure acting through the greater angle and the larger explosion pressure acting through the lesser angle, thus, to an extent, equalizing the side thrust through a greater or lesser component of the forces.

The exact amount of this offset depends on the diagram taken as representing the average running conditions of the engine, but in practice from 15 to 25 per cent. of the stroke is the usual figure. Anywhere within these limits is probably near enough, owing to the variations in the working of the engine.

Fig. 2 shows approximately the same conditions as Fig. 1, with the exception that the cylinder is offset 20 per cent. of the stroke, or 0.90 inch. Plotting the thrust curves by the same method as previously outlined shows several interesting results. The side thrusts during the two strokes are very nearly equal, as are the areas of the thrust curves; the maximum thrust is decreased, thus relieving to quite an extent the stresses on the studs securing the cylinder to its base. The points P and Q show where the side thrust changes from one side of the cylinder to the other.

Another feature incident to this design is the stroke being a little longer than the diameter of the crank circle, this variation increasing with the offset of the cylinder. For this reason the diagram in Fig. 1 does not exactly apply to Fig. 2, but they are shown together for convenience.

Helps Four-cycle Engines Most

The offset cylinder construction is of more advantage for four-cycle engines than for two-cycle, because the former, when throttled down, develops considerable vacuum, resulting in a low compression and corresponding low explosion pressure on the piston. But if the throttle is open, a corresponding high compression and explosion pressure result, thus maintaining an approximately constant relation. For a two-cycle engine the conditions are quite different, as the exhaust ports are uncovered by the piston; so little vacuum is possible. The compression pressure is therefore nearly constant whether air or mixture is being compressed, but the explosion pressures vary widely. Since the whole idea is to equalize the side pressure of the piston it is important that the average indicator diagram be used in determining the offset for two-cycle engines, and it may just as well be used for four-cycle engines.

A Shop System for Repair Work

By A. M. Bitious

A few years ago I was in the locomotive industry, and before leaving this branch of engineering I took a job in the works, which consisted of controlling all the duplicate work. This position was made necessary on account of the large amount of duplicate work which was manufactured, and I had charge also of the supervision of the alterations and maintenance of the machine tools and of the plant generally.

The system which was employed for keeping the work well under observation was very satisfactory and about as follows:

There were two order books (pocket size, about 7x4 inches), one of which was kept by the works manager and the other by myself. They were forwarded to the commercial office every morning about 11 o'clock to have all the new orders entered. Samples of two pages in the book are shown, one being for the order and the opposite side for the progress of the work and remarks about it. As soon as the orders were entered it was my duty to see the assistant or chief draftsman about the issuing of the drawings. If they were new ones I put that remark down so as to know approximately when they would be in the shops. In the case of the drawings already existing and being in good condition, they were stenciled to the order number and the particulars written in the schedule for the use of foremen and workmen.

As soon as each drawing was issued to the shop-plan office the date was noted in my book. From the class of work on the drawings I could tell which of the foremen it should be sent to. If there were any castings on, it was sent first to the pattern shop for the pattern to be prepared and issued with an order to the foundry. The date of receipt of pattern by the foundry was noted.

The next interview was with the forge foreman, to have a promised date for the forging, which was also entered.

As soon as the castings were fettled and the forgings were ready, they were despatched to their respective machine shops, the finishing being left in the foreman's care to have them ready to be passed by me a few days before the date of inspection arranged for with the customer's inspector. The work, if satisfactory, was then sent down to the finished stores to await final inspection; when this had taken place the commercial office was notified, so as to arrange for cartage or rail transportation as the case might require.

The works manager's book was an exact duplicate of mine and was entered up each morning and delivered to him directly afterward, so that he could, when attending to the correspondence, tell at once the state of progress of all the details of any order.

The repairs and alterations were treated

ORDER .... DATE.....	PROGRESS.				
FOR: A. M. Railway Co.	Drawing Out.	Patt. in Found'y.	Mat'l Ordered.	Mat'l In.	Remarks.
No. 2760.					Cyls. cast 29-1-03.
One pair of cylinders complete with pistons, piston rods, covers, glands, packing, slide valves and spindles.	Cyls. 10-1-03	11-1-03			Cyls. bored 7-2-03.
	Pistons and covers 10-1-03.	11-1-03			Pistons and covers cast 14-1-03.
					Machining 16-1-03.
Holes for bolting to frames to be drilled small, crosshead ends of piston rods and link ends of valve spindles to be left with allowance for machining to suit existing engine parts.	Valves and glands 11-1-03.	11-1-03			Valves and glands cast 13-1-03.
	Valve, Spindles and piston rods 11-1-03.				Spindles and rods forged 18-1-03.
					Machined 23-1-03.
	Packing 11-1-03.		12-1-03	27-1-03	
					Ready for inspection 28-2-03.
Date of Delivery.....					
Inspector.....					
Customer's Address.....					
Carriage.....					
Paid. Forward.....					

TWO PAGES SHOWN TOGETHER

in exactly the same way and all put through to their respective order numbers, so that it was very easy to trace out any machine and obtain particulars as to the cost of up-keep of that particular tool. The foreman or foremen concerned in the various kinds of work on each order had a descriptive instruction sheet sent through to them, which was filed away for their own convenience and then crossed off when completed.

This job was O. K., when we were short of engine orders. Then the foremen were only too pleased to have the work; but when they were busy, it took a deal of hustling to keep all the orders up to date.

While on this job I came in daily contact with the different inspectors, the remarkable contrast between them being of very great interest. Those who knew least were naturally of the greatest inconvenience on account of not being able to tell whether the slightest deviation from the drawing was of any importance.

Interesting Tools Used in the New Works of the Societe Francaise de Constructions Mechaniques

By L. Ramakers

This company has recently enlarged its plant and has a number of interesting tools not usually found in this class of work. The work is building of bridges and structural iron, locomotives, boilers, motors, etc., and the new plant covers about 16 acres of the 30 acres owned. About 2000 men are employed.

The company has gone into the idea of having portable tools to a very large extent, and in the bridge and framework shop are six hydraulic riveters with rivet-heating furnaces, all portable and traveling to the work on tracks, so as to serve a distance of about 40 feet.

In this same department are a number of portable drills, one of which is shown in Fig. 1.

In Fig. 2 is rather a peculiar notion of mounting a portable milling machine on the end of a lathe bed. The bed, rack for obtaining feed of milling head and other details are shown quite clearly in this view.

Figs. 3 and 4 show two interesting details used in connection with the drilling and similar work on locomotive boilers. The fitting stage shown in Fig. 3 is long enough to accommodate a locomotive and tender. It consists of two long cast-iron frames or benches carrying gages for supporting the frames or boilers in their normal position. The details of this are shown in Fig. 5, so that little explanation is necessary. The portable post drills at each side of the table are adjustable in about every way, traveling along the track to any desired position; the drill point may be put in any spot wanted.

Another type of portable drilling ma-

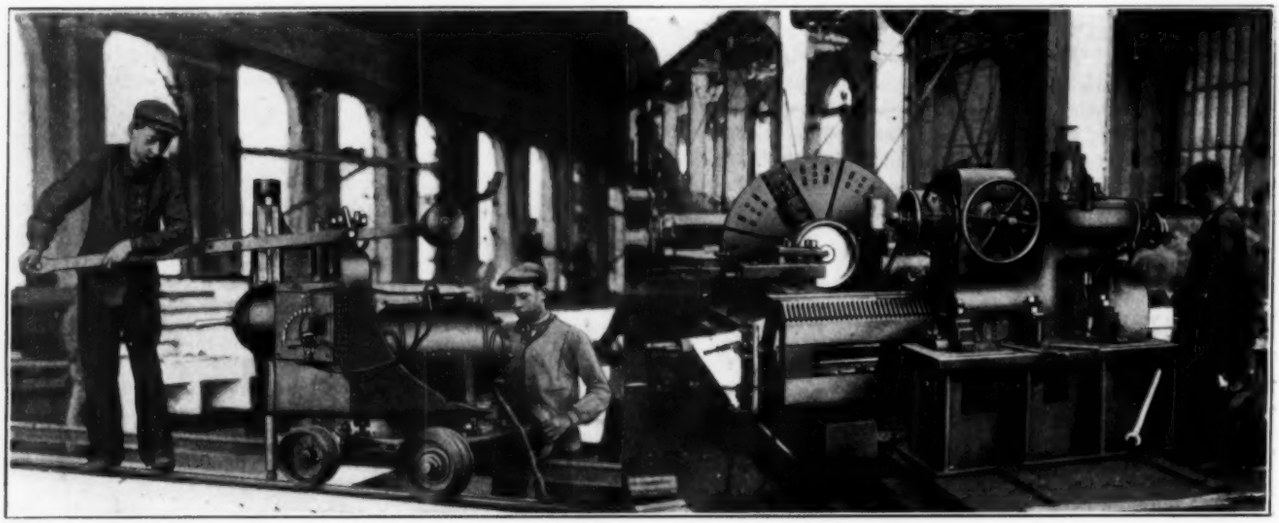


FIG. 1. PORTABLE ELECTRIC DRILLS ON TRACKS FOR STRUCTURAL WORK

FIG. 2. PORTABLE MILLING MACHINE MOUNTED ON LATHE BED

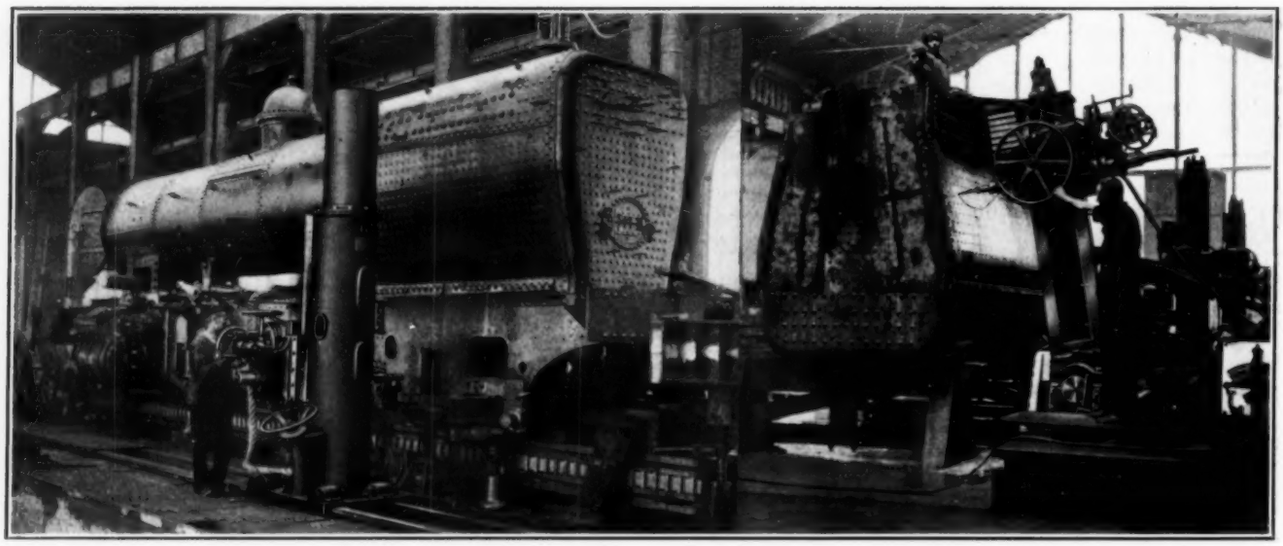


FIG. 3. ASSEMBLING STAGE AND PORTABLE DRILLS

FIG. 4. PORTABLE DRILL FOR STAYBOLT HOLES

chine is shown in Fig. 4 at work on the staybolt in the side sheets of a Belpaire type locomotive boiler. This moves along a track and is also inclinable so as to drill the holes square with the sheet. These portable tools are said to allow very rapid work in the assembling of locomotives and in the putting in of the staybolts.

The works have splendid accommodations for the men and the wash rooms contain neat lockers, of either wire or expanded metal, with wash bowls of metal covered with porcelain.

Many American tools are used throughout the works, but I have shown only those which are out of the ordinary.

High-speed Steels in the General Shop

By "English Machinist"

I have been interested for the past three or four years in the use of high-speed steels and have read most of the articles and reports which have appeared in the American Machinist on the uses to which they can be put. There may be some of your readers who, like myself, have found cases where the old makes of tool steel are still worthy of a place in the machine shop. I am foreman machinist in a shop where the work ranges from an ⅛-inch screw to jobs weighing tons. We never have jobs where we have to remove such amounts of metal as are often referred to as proof of the value of high-speed steels. Our aim and the aim of most shops is to make as little scrap as possible, and not to take 1x¼-inch cuts for the good of the scrap heap.

One or two of my experiences in the use of high-speed steel will show my position, and if your columns could print similar experiences of others it would be a benefit to all of us who are engaged in the machinist's trade, by showing us how to get the best results from the machinery that we have to work with.

I recently had a large number of bessemer steel spindles to turn, from bars 3½ to 4 inches in diameter, and about 5 feet 6 inches long. High-speed steel was used to the best of my ability. The job was in a 20-inch swing English lathe, running at about double its ordinary speed to get the right speed for the steel. The best we could do was about 40 feet per minute, and after a time we found that the tailstock center had actually been forced upward about ⅛ inch. The center was made of 1-inch square tool steel, turned to about 1 inch in diameter, where it fitted the tailstock. Although we used center drills we continued to have a good deal of trouble from the cutting and scoring of the lathe centers, causing us to stop every few minutes to scrape and adjust them. After comparing the output with the steel makers' reports we found we were getting only about one-half what they claimed for their steel.

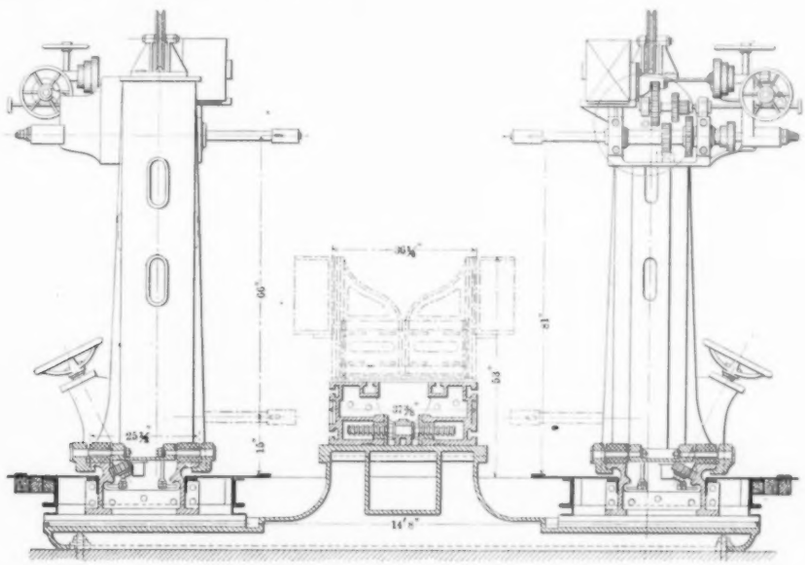


FIG. 5. DETAILS OF THE ASSEMBLING STAGE

In boring and turning gun metal and brass casting where there was a fair amount of sandy scale to contend with high-speed and the best brand of ordinary steel were used on the same jobs with the result that the ordinary steel actually stood up better and longer than the high-speed brand. The ordinary steel seemed to be the harder of the two. In drilling at book speeds on steel castings the lips of the drills soon gave out, and a machine that will drill 2-inch holes at the old speeds and feeds will only drill 5⅛-inch holes at the high-speed steel speeds and feeds.

On chilled rolls dealing with very hard specimens I have tried half a dozen makes of the leading brands of high-speed steel, and have had to fall back on the old original brand of Mushet. I cannot get the new steels anything like as hard as this old steel.

That the new steels are most valuable, and that they should be found in use in every shop is, however, beyond question, and I have benefited from them. As an instance I have turned up dynamo commutators in their bearings running at about 2000 feet per minute, using an 100-lb. air blast to keep the point of the tool cool, and had good results. Other steels gave way as if they were made of lead.

Another point which seems to me to be overlooked in the cost of production is the power required. If to do a job in high-speed style you have to put in a new lathe that will take say 10 horsepower to drive it, that means at least a shilling an hour for power, and say 10d. per hour for a machinist, that gives a power and labor charge of 1s. 10d. per hour. Instead, why not use two old-style lathes, one for roughing and the other for finishing, taking, say 5 horse-power at 6d. per hour, and have one improver, and one machinist at say 4d. and 10d. per hour, respectively, and thus have a saving in the cost of production. I think quite as much work can be had from the two old machines as from the new one, and at the same time the improver has a chance to learn his trade, to his own and the employer's ultimate benefit.

Summer School Course of the University of Wisconsin

We have received the announcement of the University of Wisconsin for its summer school for artisans for 1907. The work pursued at this summer school is intended purely for the benefit of working men, and in carrying out this idea a special effort has been made for several years to supplement the work of the correspondence schools by giving instruction in subjects which cannot be covered by correspondence. This project has been so successful that the University has now organized a correspondence school of its own, which naturally can be so laid out as to connect with the summer work in a better manner than is possible with the work of other schools. The development of the summer school work at this institution has been so successful that it may be organized into a separate school under the auspices of the University, the work being given in short terms throughout the entire year. For the coming summer courses of study are offered in Engines and Boilers, Applied Electricity, Mechanical Drawing and Machine Design, Materials of Construction, Tools and Lubricants, Shop Work, and Manual Training.

Testing Hardness of Metals and Materials

A Process Making Use of a New Form of Impact-testing Instrument Which Is Simple in Construction and Easy to Manipulate

BY W. I. BALLENTINE

The progress made in the past decade in the rapid cutting of metals with high-speed steel tools has required that we should know more about the physical properties of the metal being cut than was thought necessary under the old methods of shop management with carbon-steel tools. Had the same efforts been made to obtain the highest efficiency of the carbon-steel tools as are now made by modern shops using the high-speed steels, and had the physical properties of the metal been given the same attention as is given today, the increased production with the carbon steels would have been astonishing.

The rapid production in the modern shops of today is not due to the introduction of the high-speed steel, alone, and to which it is so often erroneously attributed, but is due to the use of the new steels and the following conditions:

1. A thorough knowledge of the physical properties of the material being worked, and their effect upon reduction by the new steels.

2. The proper arrangement of the feeds and speeds of the machine tools, so that they may be adjusted to take advantage of the physical properties of the metal being worked.

3. An accurate knowledge of the reduction properties of the high-speed steels.

4. Last, and most important of all, a system of shop management, which directs, with a thorough knowledge of the conditions named above, the efforts of its working force, and which has for its motto, "Keep a-going."

With the old method of shop management, the machinist was the master of the "Art of cutting metals," and the speed of production depended upon his judgment. Planers were designed with only one cutting speed, and all metals machined in such tools were cut at the same speeds. Lathes, drills, and milling machines had but few speed changes, and speeds were set to suit the diameters of the work, drills or milling cutters regardless of the metal being worked. Today planers are built with several changes of cutting speeds; the number of speed changes on lathes has been doubled; drill presses and milling machines have as many speed changes as lathes; and the question confronting every shop man is, what kind, or how hard, is the metal he is working.

The modern method of directing the machine operator, or of dictating the feeds, speeds and depth of cut to be taken on a certain piece of work, requires that the ones dictating know the physical properties of the metal to be cut. High-speed steels are produced of such uniformity today that they can be relied upon; and once their cutting properties are known, hard and fixed rules can be set for their use upon the same piece of metal.

If the metals used in the various branches of the mechanic art were of the same physical properties, the problem of maintaining the maximum efficiency of the high-speed steel would be a very simple one. Of all of the elements affecting the cutting speed of tools, that of hardness of the metal being cut is one of the most important. In the experimental work that has been done on the cutting of metals, very little has been accomplished in determining the hardness of the metal being cut, and today in setting cutting speeds the hardness is a question of guess-work.

Methods of Testing Hardness

Of the several methods used today for determining the hardness of metals, the three described below are most generally used. The first is Professor Turner's machine, in which the hardness is given in terms of grams required to cause a diamond to scratch a polished surface. The second is Chas. A. Bauer's drill test, in which a drill is run at a constant speed and a constant load applied tending to feed the drill into the metal being tested. The hardness is recorded by noting the relation of the number of revolutions made by the drill and the depth of penetration. In the Keep hardness-testing machine, designed on the same principle, a chart is used which records any variation in hardness for the full depth of the test. The third is the ball test, in which a hardened-steel ball is pressed into the surface by a known pressure, and the hardness recorded by measuring the depth of the impression made by the ball.

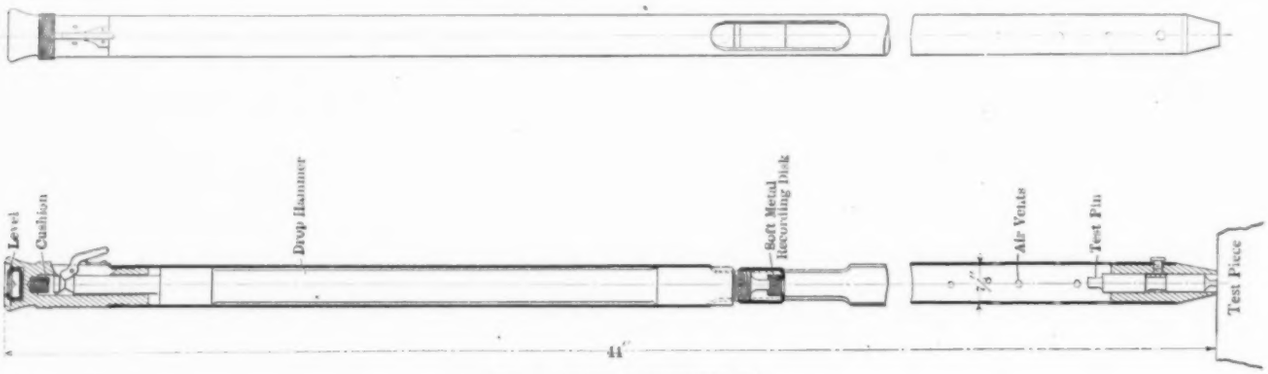


FIG. I. TESTING INSTRUMENT

The field of the methods described above is confined to the laboratory, on account of the preparation of the test pieces and the design of the testing machines. Another objection to these methods of testing hardness is the fact that the test piece, being small, is rarely of the same hardness as the piece on which the hardness is required to be known. For these causes they are rarely used commercially.

The writer, while shop engineer for the Link-Belt Company, at Philadelphia, was much interested in the work done by the experimental department of that plant on the testing of the hardness of metals along the lines of Bauer's method. This method, after continued trial, was found to be variable and impracticable.

The only practical solution of the problem appeared to be in an instrument that could be carried to the piece to be tested, and thus eliminate the separate test pieces. With this object in view, the instrument for testing the hardness of metals and

other materials was designed, as shown in Fig. 1.

The Testing Instrument

The instrument consists of a guiding tube incasing a sliding hammer, which can be held at the top of the tube by a spring latch. At the lower end of the hammer is a small anvil, on which is fastened by a screw cap the soft-metal recording disks. At the lower end of the tube a small test pin is held in a guide. On the upper end of this pin is an anvil similar to the anvil on the lower end of the drop hammer. The lower end of the test pin has a small hemispherical point for penetrating the metal to be tested. A small bird's-eye level is mounted on the tube cap for plumbing the instrument. Two slots are cut in the sides of the guide tubes, so that the recording disks may be removed without taking the hammer from the tube. The tube is also provided with air vents to prevent the cushioning of the hamber in dropping. The instrument weighs about four pounds, and can be readily carried to any piece to be tested.

The Theory of the Process

The theory of the process of testing the hardness of materials with this instrument is as follows: A predetermined testing force (the drop hammer of known weight falling through a known distance) is transmitted to the material being tested through two bodies, one of which is softer (the recording disk) and the other which is harder (the test pin) than the material being tested, and the deformation of the softer or the recording disk is measured. If the material being tested is very hard, such as chilled iron, or semi-hardened steel, the recording disk will be penetrated to a much greater depth than were the test on soft brass. The energy of the impact is absorbed by two bodies, the material being tested, and the soft-metal recording disks. Therefore the recording disk, offering a constant resistance to penetration, will be penetrated to varying depths, as the resistance of the materials being tested to penetration varies, or the penetration of the recording disk would vary as the hardness of the metal under test varies.

Method of Preparing a Piece for Test

If the piece to be tested is in a machine, a cut may be run about one-eighth of an inch wide, and the surface touched up with a file. If it is desired to test the hardness of the scale, a spot large enough for the test point may be smoothed off with a file; or if the hardness below the scale is desired, a spot may be chipped out and smoothed up.

Method of Recording the Hardness

In Fig. 2 a recording disk is shown before the test has been made, and after the test. The small impression in the disk before the test is made is for centering it on the recording anvil. As the thickness of the recording disk, after having been used varies, being thinner the harder the metal being tested, it is only necessary to measure the thickness of the disks with a micrometer, and this dimension in thousandths of an inch may be used as the class of the hardness. Thus if a recording disk measured after a test 0.156 inch, the class of hardness would be No. 156, and a metal of No. 148 hardness would be harder than No. 156.

In the test recorded below, the amount of penetration in thousandths of an inch was used as the hardness class. This method, however, requires that the remaining thickness be subtracted from the original thickness of the disk, which is not as convenient as the method described above.

Hardness Test of a Cast-iron Wedge

Cast iron of the same chemical properties will vary in hardness due to the variation in thickness of the casting, being harder in thin castings than in thick ones. A test was made on a gray-iron wedge to demonstrate this point. The results are given in the table:

FIG. 2. RECORDING DISK

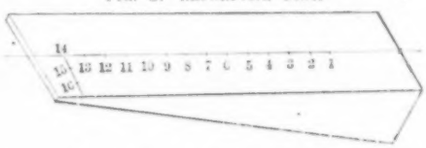


FIG. 3. THE CAST-IRON WEDGE

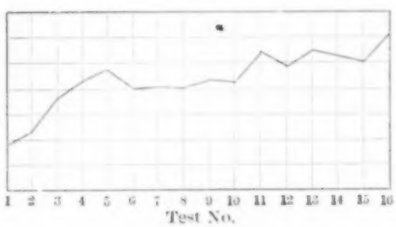


FIG. 4. HARDNESS DIAGRAM FROM CAST-IRON WEDGE

Test No.	Thickness of Disk Before Test.	Thickness of Disk After Test.	Penetration.
	Inch.	Inch.	Inch.
1	0.28890	0.15665	0.13225
2	0.28870	0.15585	0.13285
3	0.28880	0.15430	0.13450
4	0.28895	0.15360	0.13535
5	0.28915	0.15325	0.13590
6	0.28875	0.15375	0.13500
7	0.28910	0.15400	0.13510
8	0.28865	0.15355	0.13510
9	0.28895	0.15352	0.13543
10	0.28915	0.15377	0.13538
11	0.28900	0.15312	0.13688
12	0.28900	0.15295	0.13605
13	0.28950	0.15267	0.13683
14	0.28860	0.15210	0.13650
15	0.28900	0.15280	0.13620
16	0.28920	0.15153	0.13767

Fig. 3 shows the wedge, which was about 9 inches long, 2 inches wide, tapering from 1⅞ inches to 1/32 inch. This test piece was prepared by surfacing and grinding one side, and tests were made along the center line, as shown in the figure numbered from 1 to 14 inclusive, and two others, 15 and 16, at right angles to the center line.

In Fig. 4 is shown a curve of the hardness plotted from the penetration corresponding to the test number. The process described above can be used for testing the hardness of steel plates for engraving purposes, copper for its various uses in electrical manufacturing, soft metals such as babbitt, and steel rails and plates, and various other materials.

Process patent was allowed on the invention by the United States Patent Office, in April, 1907, and there are other mechanical patents pending.

Notching Die for Armature Core Disks

By F. Johns

The usual method of making dies for notching armature core disks is shown at Fig. 1, with a section of a disk above it.

The portion *A* is the notch proper, the part *B* forming the groove for the insulating wedge, which holds the wire in place, and *C* the outer or edge-trimming part of the die.

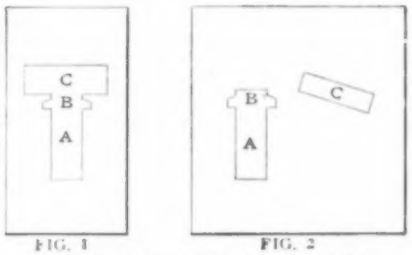


FIG. 1 FIG. 2

NOTCHING DIE FOR ARMATURE CORE

The weak points are the small corners between *B* and *C*, as on small dies these may not be over 1/32 inch thick, and if not made very carefully they will break, even on the thinnest plates.

By making the die as in Fig. 2, there is no danger from this source, the die costs no more to make, and will last very much longer, as it can be left at a higher temper when drawing. The disk revolves in either case. Here the slot is cut by die *A* and *B*, and is trimmed by *C*, while the next slot is being punched.

The imports into the United States during the month of February, 1907, were valued at $123,185,209, of which $54,990,559 was free of duty, and $68,194,650 dutiable, against a total of $104,232,879 for February, 1906. The exports during the same month amounted to $159,548,646, of which $157,526,143 was domestic, and $2,022,503 foreign, against a total of $141,766,558 for February, 1906.

Manganese Steel and Some of Its Uses

Its Advantages over Carbon Steel for Rails Subject to Severe Wear, for Burglar-proof Vaults, as well as Some of Its Peculiarities

BY E. F. LAKE

Manganese steel is one of the new steel alloys which have been brought out in the past few years, some of the others being chromium steel, nickel steel, chrome-nickel steel, vanadium steel and tungsten steel. These new discoveries and new alloys of steel have doubled and in some cases more than doubled the wearing qualities, tensile strength, elastic limit and the ability to withstand shock and torsional stresses. The improvements along this line have been greater in the last twenty-five years than in any preceding hundred years in the history of the steel industry.

Where Manganese Comes from

Manganese ore is obtained in the United States and many other countries, but the ore of the highest commercial quality is found in India and the buyers of this country and England stand ready to take all that is produced there. It is present in, or added to, nearly all grades of iron and steel. Nickel-chrome, the highest grade of steel made, contains 0.4 per cent. manganese, and it goes up to as high as 2 per cent. in some of the carbon steels.

It has been one of the components of steel for many years, but its true properties and effects on steel were not known until about twenty years ago, when they were discovered by R. A. Hatfield, a metallurgist and steel maker of Sheffield, England. Its effect when added to steel up to 2 per cent., with various percentages of carbon, is best shown by Diagram 1, the actual mode of existence of the carbon in the steel being very important.

Peculiar Effects on Steel

When more than 2 per cent. and less than 6 per cent. of manganese is added, with the carbon less than 0.5 per cent., it makes steel very brittle, so that it can be powdered under a hand hammer. From 6 per cent. of manganese up, this brittleness gradually disappears until 12 per cent. is reached, when the former strength returns and reaches its maximum at 15 per cent. After this, a decrease in toughness, but not in transverse strength, takes place until 20 per cent. is reached, after which a rapid decrease again takes place.

Steel with from 12 per cent. to 15 per cent. of manganese and less than 0.5 per cent. of carbon is very hard and cannot be machined or drilled in the ordinary way; yet it is so tough that it can be twisted and bent into peculiar shapes without breaking. It is malleable enough to be used for rivets that are to be headed cold.

Most Durable Metal Known

This hardness, toughness and malleability make manganese steel the most durable metal known, in its ability to resist wear, for such parts as the teeth on steam-shovel dippers, where they will outwear about three teeth made of the best tool steel; for plow points on road-building work; for frogs, switches and crossings in railroad construction; for fluted or toothed crushing rolls used on ore, coal and stone crushers; for screen shells to screen these crushings, and numerous

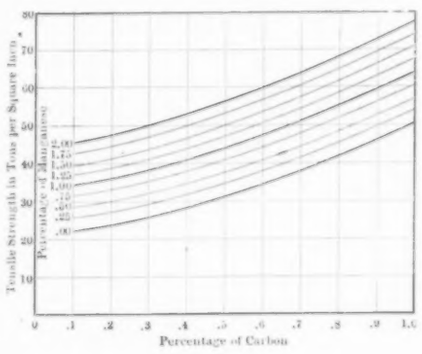


DIAGRAM 1

things of a like nature, as, for instance, gears, sprockets, link belts, etc., when used in the vicinity of ore, stone and coal crushers or other places where they are subjected to the hard, grinding wear of the gritty particles of dust with which they are usually covered.

Carbon and Manganese

The higher the percentage of carbon in the steel, the less percentage of manganese will be required to produce brittleness. Silicon, however, neutralizes the injurious tendencies of manganese, and in Europe the silicon-manganese alloy is used to a large extent for making automobile springs and gears. This steel is not high in manganese and can be rolled, while the peculiar properties given to steel by the addition of from 12 to 15 per cent. of manganese make such steel impossible to roll; therefore all parts made of this steel have to be cast, after which it can be forged and rendered tougher by quenching from a white heat.

Softened by Rapid Cooling

One of its peculiarities is that it is softened by rapid cooling and can be restored to its former hardness by heating to a bright red.

Manganese resembles carbon in its power to harden steel and has a strong tendency to prevent the development of the crystalline structure, thereby refining the grain and making the steel homogeneous and free from blowholes.

Manganese steel does not differ from other steels in weight or specific gravity, but owing to its great strength and toughness, which render it capable of withstanding shock or torsional stresses, it can be made of a smaller section than the ordinary carbon steel. Hence, the weight can be reduced.

Difficult to Mold

Its melting point is about the same as other steels—that is, 2500 degrees Fahrenheit—but it is more difficult to mold in the foundry than the ordinary cast steel, as it must be poured at a very high temperature, and in cooling it shrinks nearly twice as much; or, to be more specific, the shrinkage allowed for patterns to be cast of the ordinary cast steel is 3/16 of an inch to the foot, while for manganese-steel castings the pattern must be made 5/16 of an inch to the foot larger than the casting is to be.

Heavy Shrinkage Limits Use

This enormous shrinkage makes it impossible to cast in any intricate or delicate shapes, and as it is too hard to machine or drill successfully, all holes must be cored in the casting. If a close fit is desired in these, they must be ground out with an emery wheel.

These properties limit its use to a large extent, and where the same good qualities are demanded of a steel that can be machined, rolled and tempered, the more expensive nickel, chrome or chrome-nickel steels are used.

The Right Composition

The following is the composition most desired in manganese steel, as after many experiments and tests it seems to give the best results:

Manganese, from 12 to 15 per cent.
Carbon, not over 0.5 per cent.
Phosphorus, not over 0.04 per cent.
Sulphur, not over 0.04 per cent.

Carbon steel does not withstand alternate shock and torsional stresses with anything like the tenacity of the alloy steels, nor does it possess any of the virtues of alloy steel when it has to stand an overload of any kind. Sudden rupture is a term especially applied to carbon-

steel products, although the term "fatigue" would probably be more appropriate. To avoid this undesirable property investigations were started, and one of the results of these was the discovery of manganese steel.

One of the wonders of metallurgy is the effect that a small percentage of carbon has upon iron. Pure iron has a tensile strength of 5400 pounds per square inch, and if we add a few tenths of one per cent. of carbon, the tensile strength immediately rises to 60,000 pounds per square inch or more. This is a quantity so small that it is out of all proportion to the mass in which it is distributed.

Phosphorus Bad for Steel

Phosphorus and sulphur are impurities that should be kept as low as possible in all steels, especially is this so in manganese steel, where strength and toughness are its good qualities. If high in phosphorus, a "cold-shortness" is produced and the metal is easily broken, especially in frosty weather, with which steam shovels, ore crushers, etc., have to contend in their outdoor work. Thus steel may be rendered very tough by the addition of the proper percentage of manganese, and this good quality entirely destroyed by allowing the phosphorus to be too high.

FIG. 1

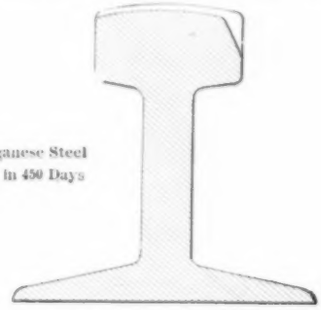


FIG. 2

FIG. 3

FIG. 4

WEAR OF RAILS ON BOSTON ELEVATED RAILROAD

Unless the metal is to be forged, the sulphur contents are not so important, as it does not effect the metal except when heated; then cracks are liable to develop if the sulphur is too high.

Annealing Castings to Remove Strains

Manganese-steel castings should be annealed in order to remove any internal strains which may be caused by its high shrinkage and the fact that the outer surface cools so much quicker than the core, which leaves the center of the casting strained. This can be done by heating to 1500 degrees Fahrenheit and quenching in water, after which it can be hardened by heating to 900 degrees and allowed to cool slowly.

Manganese-steel castings, when tested from a ⅞-inch round test bar, two of which should be taken from each heat, should show the following characteristics:

Tensile strength, per square inch, not less than 140,000 pounds; elastic limit, per square inch, not less than 90,000 pounds; reduction of area, not less than 50 per cent.; elongation in 2 inches, not less than 20 per cent.

Tensile Strength and Elongation

The comparison between the tensile strength and percentage of elongation between manganese steel and other metals is best shown by Diagram 2.

With a low percentage of sulphur and phosphorus, manganese steel does not chip or spall off easily and wears down evenly, without cupping. This makes it one of the best alloyed steels known for the shoes and dies of stamping mills. It is also used to protect the sides of the mortar, with lining plates.

Makes Good Rails

In some places where bessemer-steel rails have shown an enormous wear, cast manganese-steel rails have been used successfully, although the difference in price is so great that only in rare instances has this proved an economical factor in railroad construction; but this steel is used in many places for frogs, switches and crossings.

The manganese-steel rails are approximately $5 per foot, while the bessemer-steel rails are about 38 cents; thus the manganese rail would have to outwear 13 bessemer rails to make it profitable. If we deduct from this the labor cost in taking up the old rail and replacing with new, this might be reduced to 11 or even 10.

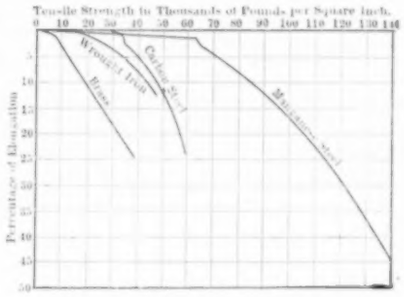


DIAGRAM 2

Use on Boston Elevated

On the Boston elevated, where the curves are sharper than on any other road in the country and each car in the train is a motor car, which increases the wear, as each wheel is driven and liable to grind holes in the rails when the train is stalled, manganese rails have been used with good results. Figs. 1, 2, 3 and 4 show the results on one particularly bad curve. Fig. 1 shows the wear in a bessemer rail that was down only 45 days. On this curve that was about the average life of a low carbon rail.

The sectional lines show the rail when it was taken up and the plain line the original size, or as it was when put down 45 days before. The bessemer also crushed out at the side as well as wearing down 0.78 of an inch.

Manganese Rails Pay Here

Fig. 2 shows a cast manganese-steel rail which was put in the place of this one. At the end of 450 days it showed a grinding down of only 0.132 of an inch. Fig. 3 shows the same rail at the end of 1000 days, with a wear of 0.2 of an inch. Fig. 4 shows a nickel-steel rail at the end of 200 days, with the wear 0.52 of an inch.

A special grade of bessemer rails that was high in carbon was rolled, and these lasted about three times as long as the commercial bessemer rail shown in Fig. 1; but these were changed so frequently that it made them too expensive. The traffic at the place where these rails were used was 44,000 tons a day, and it was a reverse curve, with a radius of 82 feet, or nearly 75 degrees. This difference in wearing qualities makes the manganese-steel rail economical to use where rail renewals are expensive to make.

Rails Twenty Feet Long

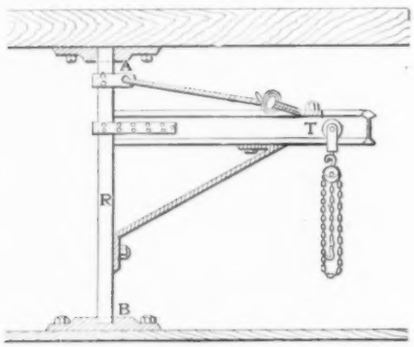
Owing to the difficulties of casting manganese steel, the rails can be made in 20-foot lengths only, and the web and flange must be of much larger section than in the rolled bessemer rails. This makes them considerably heavier, but they can be cold bent readily to a radius of 20 feet and have been bent to a radius of 10 feet without showing any signs of fracture, thus proving their ductility.

Manganese steel has also been used to build burglar-proof safes, and is used to quite an extent for window guards and door screens in the construction of jails, prisons, etc., owing to its being too hard to file or saw, and at the same time ductile enough to withstand any kind of sharp blows.

A Home-made Jib Crane

By M. Berlin

No machine yet invented is so nearly indispensable in a shop or engine room as the traveling crane, and a shop without one is greatly handicapped, if it is obliged to handle heavy work.



A HOME-MADE JIB CRANE

I worked in a shop where a large crane was needed, but it was considered impractical to install such an expensive machine for a small shop, and for quite a while we were obliged to unload heavy work by means of skids and then roll it about the shop.

We finally decided to erect a small jib crane in the most desirable part of the shop, where it could be used to unload heavy material, and also transfer it to, or near, the different machines.

We built it out of old material gathered up around the scrap heap, as shown. The standard *R* was cut from an old piece of 3-inch shafting, while bearings for top and bottom ends *A* and *B* were made from reinforced blank-pipe flanges. Suitable grooves were cut around the bottom of the shaft to facilitate lubrication.

A one-ton chain block was hung on the trolley *T*, which ran on the I-beam, which was long enough to cover a circle 20 feet in diameter.

Boring an Ellipse on the Milling Machine

By Albert F. Shore, M. E.

About two years ago I happened to place an order for an elliptical punch and die with a supposed up-to-date toolmaking shop. I asked these people to produce an ellipse theoretically perfect, and after giving the two dimensions I was assured that my request would be granted.

About a week later I again visited the

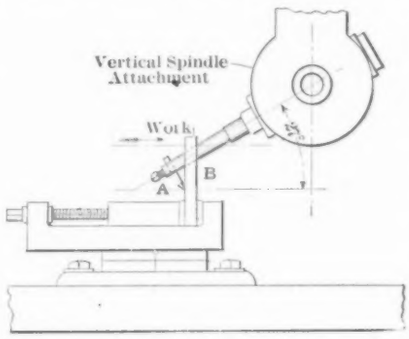


FIG. 1
THE ELLIPSE BORING RIG

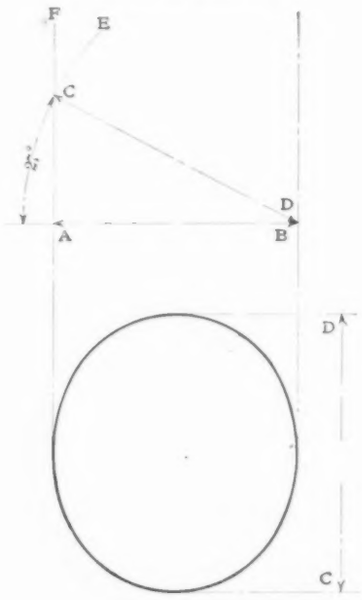


FIG. 2
THE ELLIPSE DIAGRAM

shop and found the die just finished—that is, it was filed up and polished—but I could not reconcile myself to the alleged fact that the filed hole was an ellipse. It was rather a bungling attempt at one, and had the usual four-cornered appearance of those laid off with the dividers. What should be done? The boss argued that the curve of a real ellipse was one quite too delicate for the human eye to design and especially to file out, and subsequently offered to construct an ellipse engine after the manner of the ellipsograph for $75, and use it to bore out the die.

The idea was not bad, but the extra item of $75 and the annoying delay were enough to set one to thinking.

I started to size up the untried powers of the lathe and the universal milling machine, and in just ten minutes hit upon a way to bore out the die so that it would come theoretically true. The stampings were to act as a cam to reconvert the desired elliptical shape into a true circle by means of a lever, and *vice versa*. Not only could I rig up their compound-rest lathe to do this work, but the milling machine as well, by using nothing but a boring bar already at hand.

Without resorting to trigonometry I drew a diagram as in Fig. 2, in which *A B* was the short diameter and *E D* the long diameter. Line *A B* was first drawn, and then the dividers were set to the length *C D*, or the length of the ellipse. Finding a center in the line *A B*, the arc *E* was drawn; and by carefully noting the intersecting point with line *F*, the line *C D* followed. By the use of a draftsman's protractor it was an easy matter to measure the angle in degrees between the hypotenuse and the short side. It was 27 degrees.

As applied to the milling machine the "*modus operandi*" was as follows: The vertical attachment was put on in the usual way, and a plain end boring bar inserted. This was set at an angle of 27 degrees, as shown in Fig. 1. A double-edged pointed tool *A*, Fig. 1, was put in the boring bar, and set long enough to reach to the largest diameter of the desired ellipse.

The die plate was clamped in the vise, and set square, as at *B*, Fig. 1, after having centered the point of the tool *A* with the inaccurate hole in the die. The plate was then fed outward enough to take a light cut from the elliptical hole, which it did with all anticipated success. Indeed I saw my die bored out true before I left the shop that afternoon.

It is a very odd-looking sight to see an ellipse bored in the manner described, and the sensation the performance caused in that shop was amusing. Everyone abandoned his work to look on, while the management said nothing, for at least the first hour.

By employing my scheme ellipses of all ratios may be bored as well as turned, as in the case of cutting elliptical bars; although in the case of boring, the greater the ratio the more limited is the depth which can be bored before the bar will strike the plate, and thus stop the work. To bore thick plates the spindle may be swung over to the opposite side and thus made to bore in from the opposite side of the plate, the holes meeting "tunnel fashion."

A compound-rest lathe can be used for the same purpose, and with the same principle.

Owing to the keen curiosity aroused by this process I made a small cast-iron model with some of the stock left, to in-

dicate the motion of the tool, and have handed it to more than a hundred mechanics and draftsmen as a mechanical puzzle. It was in no instance explained.

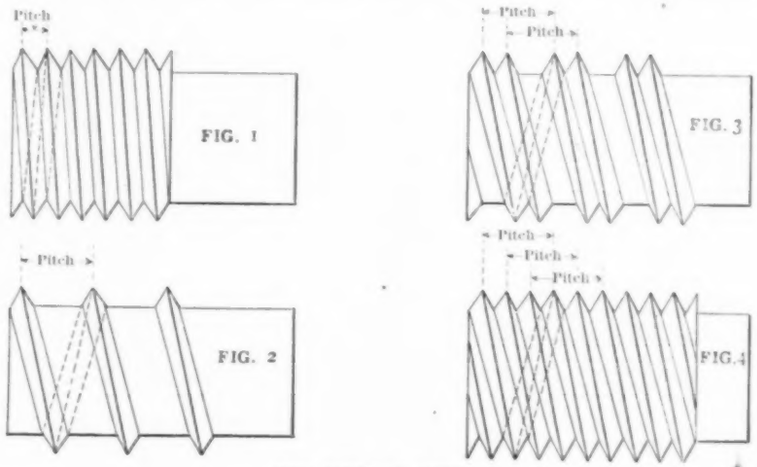
I now take pleasure in giving the wrinkle to the mechanical arts, and if it is old it is certainly little known.

[The turning and boring of elliptical sections in a lathe having a compound rest are described in the AMERICAN MACHINIST, page 19, Vol. 28, Part 2.—ED.]

What Are Lead and Pitch of Screw Threads?

BY ARTHUR B. BABBITT

What is the pitch of a screw thread? Is it the same as the lead? Is it, when cutting the thread, the distance traversed by the threading tool for each revolution of the lathe spindle? The average reader in looking at the above questions will probably feel that he can readily answer them and that they are very simple questions, but he will find upon investigation that there is quite a difference of opinion even among those who are considered authorities on the subject. Applying these questions to the single thread, I think we can all agree on our answers, it being on the multiple threads where the divided opinion exists.



THE PITCH OF SCREWS

The screw thread may be defined as a helical solid wound upon a cylinder, the cross-section of this solid determining the character of the thread. If this be the case, then we must go back to the helix for our definition of pitch, and in order to get this properly we must first define helix. The helix may be defined as a line generated by the movement of a point along a straight line while the line is revolving about an axis; therefore, a helix is a line upon the surface of a cylinder or cone. The distance traversed by the generating point during one revolution of the straight line, measured on or parallel to the axis of rotation, is called the pitch of the helix.

If we use a surface whose plane passes through the axis of revolution to generate a helical solid about the cylinder, every point of the surface will generate a helix and the diameter of the cylinders upon which these helixes may be drawn will equal twice the distance from the point to the axis of revolution; however, the pitch will be the same for all.

NO CHANCE OF ERROR IN SINGLE THREADS

In Fig. 1 the helical solid or screw thread is generated by an equilateral triangular surface, the pitch being equal to one side of the triangle. In this case the pitch may be measured from point to point of the thread. If, however, the pitch of the helical solid had been made three times as great as the side of the triangle, we would have had a result similar to that shown in Fig. 2, in which the pitch would be equal to the distance from point to point of the thread, or as printed on the drawing.

By using the same size generating surface we may wind a second helical solid around the cylinder and alongside of the one shown in Fig. 2, the result being as illustrated in Fig. 3. The pitch of each helical solid is indicated on the drawing. If we wind still a third thread about the cylinder, filling in the blank space shown in Fig. 3, we would have a triple thread, illustrated in Fig. 4, the pitch of which would be equal to the pitch of the thread shown in Fig. 2. The pitch of each helical solid is indicated in the drawing. Reasoning in this way, the pitch of the screw is equal to the pitch of the helix, the distance traversed by the nut for each revolution and the distance through which the threading tool passes for each revolution of the lathe.

WHAT ONE GOOD AUTHORITY SAYS

The above statement agrees with many authorities I have consulted, but others define the pitch as the distance between corresponding points of adjacent threads, whether the thread be single or multiple. A "Handbook for Apprenticed Machinists," edited by Oscar J. Beale and published by the Brown & Sharpe Manufacturing Company, uses the term "lead" as the distance the thread advances in one turn, and the term "pitch" or "thread pitch" as "the distance from the center of one thread to the center of the next thread measured in a line parallel to the axis." Under the caption "Pitch and Lead" the handbook says: "The term 'pitch of a screw' is still sometimes used in the sense of 'lead,' but in a machine shop 'lead' is much clearer, as it cannot be confounded with turns to an inch, nor with the pitch of the thread." Quoting again from the same book we have: "In a single-thread screw the pitch is equal to the lead; in a double-thread screw the pitch is half the lead; in a triple-thread screw the pitch is one-third the lead, and so on."

OTHERS WHO DIFFER

After reading the section above referred to I looked about to see where "the term pitch is still sometimes used in the sense of lead," and found that in "Mechanical Drawing and Machine Design," by John S. and David Reid, a text-book written for and in use by the students of mechanical drawing and machine design in Sibley College, Cornell University, the authors say: "The pitch of a screw thread is the lineal distance its nut would advance along the axis in one turn. In a single-threaded screw the pitch is the distance between the centers of two consecutive threads measured in the direction of the axis; in a double-threaded screw it is the distance from center to center of every alternate thread, and in a triple-threaded screw it is a distance that will embrace three threads."

In "A Manual of Machine Drawing and Design," by Low and Bevis, may be found the following: "The distance which a nut advances for one revolution of its screw is equal to the pitch of the thread of that screw. Now it is evident that if with a screw of given diameter it is required that the nut shall move a considerable distance for one revolution of the screw, the pitch of the latter must be large, and if the thread is square, its depth will be half the pitch, and therefore may be so large that the diameter of the screw at the bottom of the thread would be so much reduced as to make the screw too weak. This difficulty is surmounted by making the screw with two or more threads, each having the same pitch and running parallel to one another;" also, "the pitch of a screw divided by the number of threads is called the divided pitch."

In Anthony's "Mechanical Drawing," while no definition is given, we have a sketch showing clearly that the author uses the term pitch as the distance the thread advances in one revolution and not the distance between adjacent threads. This last is the text-book used in the

engineering department at Tuft's College.

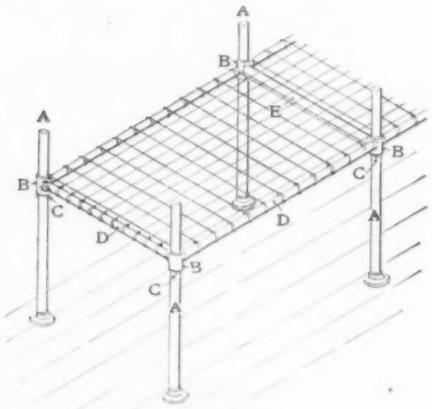
WHICH IS GENERALLY USED?

Can it be that our engineering schools are doing work that, in the little things, is of the "still sometimes" variety, or is it that the terms used in the Brown & Sharpe handbook are in general use only in their factory and by men who have been educated there and gone elsewhere? There is surely a divided opinion among shop men, for during the past few months I have had, and have taken advantage of, the opportunity to ask many of them about this subject, and I find that not only is there a difference of opinion, but that many have a combination very confusing.

A Pattern-storage Rack

BY H. L. STRONG

It may be that some of your readers are interested in pattern-storage racks. The illustration shows a type recently designed and constructed for our use which has proved satisfactory.



A PATTERN-STORAGE RACK

The frame is made entirely of common pipe that has passed its usefulness as a conductor of water or gas, and special cast-iron fittings without threads. The posts *A* are of 1¼-inch pipe, continuous from floor to ceiling, and pass through the larger portions of the fittings *B*, which are held in place by a ¼-inch pin *C*. The tops and bottoms of these posts enter plain unthreaded flanges which are screwed to the ceiling and floor.

The shelf railings and cross bars *D* and *E* are 1-inch pipe and fit over bosses on the fittings. The shelf is a sheet of wire fabric 2x3 inches mesh, No. 10 galvanized wire, electrically welded at all intersections, the ends of the wires being left long enough to wrap twice around the rail and fasten. This shelf binds the whole framework together so securely that it is unnecessary to fasten the rails and crossbars to the fittings.

Cost of erection will compare favorably with wooden shelves, and the advantages of better light, less danger from fire, and less dust and dirt will commend the type.

A Set of Shell-drawing Dies for a Single-acting Press

BY JULIUS F. A. VOGT

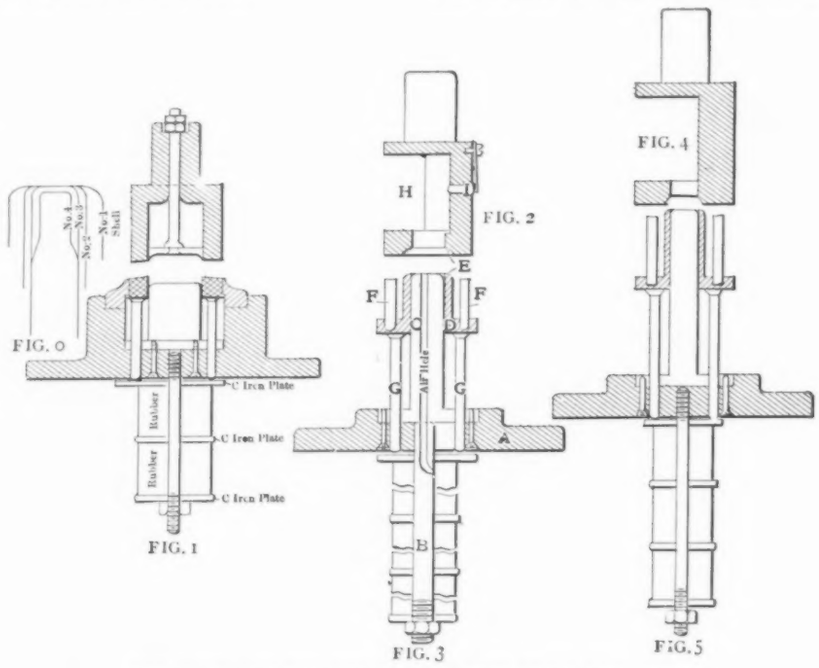
There are two new features in this set of dies. One is the cut-away punch for discharging the work out of the side of the punch, for rapid operation. The second, and more valuable, is the contact pins *F*, Fig. 3, which make a connection between the face of the punch and the pressure attachment below the dies.

By means of three pins *F* the pressure on redrawing the shells is always uniform, no matter how deep a draw is made. Without these pins, the pressure will increase the deeper the shell is drawn, and if it goes beyond the strength of the material, the shell will break.

Fig. 1, the first operation die, is a combination cutting and drawing die, such as is commonly used for this class of work and needs no description. This die produced the shell No. 1, which is 2 inches diameter by 1½ inches deep. Two rubber bumpers of 3¾ inches diameter by 6 inches long, with a cast-iron plate between them, were used as a pressure attachment.

Fig. 2 is a redrawing or reducing die for reducing the shell No. 1 made in the combination die, Fig. 1, from 2 inches diameter to 1¼ inches diameter.

Part *A*, Fig. 3, is a cast-iron die bed faced off on the bottom and provided with a threaded hole for the spring stud *B*. The steel forming part *C* was then roughed out, and three screw holes drilled and tapped into the flange of it. The die bed *A* was then faced on the



THE WORK AND THE DIES FOR THE FIRST THREE OPERATIONS

The shells were drawn 3¼ inches deep, allowing for trimming both ends, so that the finished shell was 3 inches long. The drawing Fig. 0 gives full dimensions of the shells. They were made of soft brass, 0.012 thick.

The outside diameter of the large end of the shell had to be 0.994 minimum, 0.995 maximum; the inside of the large end was not particular. The outside of the small end of the shell had to fit closely into a brass cap of 0.640 inside diameter, and the inside had to be a close sliding fit on a brass tube 0.622 outside diameter, thus allowing a thickness of metal for the small part of the shell of 0.009 only, when finished. To draw a shell of such light material to a length of 3¼ inches by means of a single-acting press is not as easy as it looks, and the following description of the method and tools employed will show how it was done:

front and recessed to receive forming part *C*. The three screw holes were transferred from *C* to the die bed *A* and drilled and countersunk. *C* was fastened to *A* by three fillister-head screws. The die bed *A* with the forming part *C* was then put on to the lathe, and a ⅜-inch air hole drilled through the center of *C*. The outside of *C* was then finished to 1¼ inches diameter, hardened, ground and polished.

The blank holder *D*, or as I would call it in this case the shell holder, was made next. A piece of tool steel was bored out to a sliding fit on the forming part *C*. The outside of this was then turned so that shell No. 1 would fit loosely over it, the round corners of the shell holder to fit exactly in the shell. The shell holder was then highly polished.

The punch, Fig. 2, was then made. First the shank was turned to size, then the front part was bored and fitted to

the forming part *C*, allowing about 0.036 for the two thicknesses of brass. The face of the punch was then fitted to shell No. 1, so that when the shell was slipped over the shell holder and the face of the punch set on top of it, there was a perfect fit on the rounded corners at *E*, Figs. 2 and 3. The punch was then bored ⅛ inch larger from a point ¾ inch from the face, the depth of the entire front part of the punch. Then the punch was cut away on one side as shown at *H*, Fig. 2, and the spring pin *I* was put in, to throw out the shell.

The holes for the pressure pins *G* were then drilled through the die bed, the pins were made, and the die was ready for the test. It will be seen in Fig. 3. There were three rubber bumpers, each 6 inches long, with two cast-iron plates between them to divide the pressure, and to make it as uniform as possible. The first shell that was tried broke when drawn, to about three-quarters of its depth. A couple more were tried with the same result. I knew that the punch was fitted properly, and that the breakage of the shells was not due to a too tight fit of the punch. It then occurred to me that possibly the increasing pressure of the rubbers might be the cause of the breakage. Some time ago I had an idea how the increasing pressure in such a case could be overcome, and the following explanation will show how it was done.

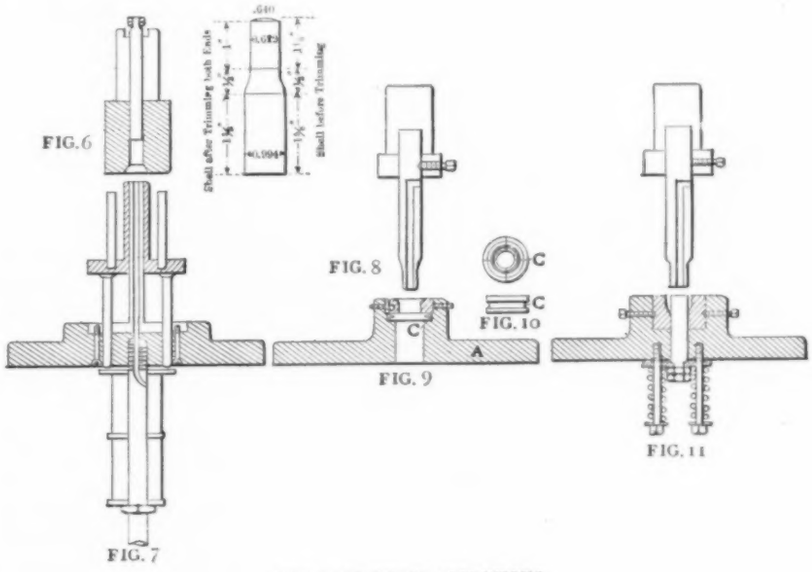
We took the part *D*, Fig. 3, and drilled partly into it three holes a driving fit for a 7/16-inch drill rod, leaving the bottom in these holes. The three pins *F* were then made, and driven into these holes. The tops of these pins were then faced off, so that when the shell was put on to the shell holder *D* and the punch, Fig. 2, was placed on top of it, the face of the punch would rest on the three pins *F*. The bottom side of part *D* rested on the pressure pins *G*, and the pressure pins *G* on the cast-iron pressure plate held up by the rubber bumpers. It will be seen by the drawing, Fig. 3, that the punch is pressing directly on the rubber by means of the pins *F*, leaving just space enough for the metal to slip through when the press is in action. In other words, the increasing pressure of the rubber, causing the breakage before, was changed by means of the pins *F* into a uniform pressure like that of a drawing press. The die was tried again and it worked to perfection.

Next we reduced the shells from 1¾ to 1 1/32 inch diameter. A die was made for this purpose, similar, excepting in size, to the one just described. This die is shown in Figs. 4 and 5. Figs. 6 and 7 show a die and punch for reducing one end of shell No. 3 to ¾ inch diameter, 1 inch long. This die is the same in construction as that in Fig. No. 3. The punch, however, is provided with a knockout to discharge the partly reduced shell.

Figs. 8 and 9 show a sizing die and punch, for the large part of the shell. *A* is a cast-iron die bed with a hole let through it 1/16 inch larger than the large part of the shell. The tool-steel ring, *B*, Fig. 9, was then bored and turned to nearly its size. The ring was then hardened and ground to 0.994 inside diameter. The stripper ring, Fig. 10, was then made and on the outside of the ring the groove *C* was cut. The upper inside corner of this ring was nicely rounded and polished and the ring was cut into three equal parts. A tight spring, about ¼ inch outside diameter, was made from light spring wire; the spring was formed to a circle by hooking the two ends together, and it was then sprung into the groove in *C*. The die bed *A* was then bored out to receive the sizing and stripper rings. The sizing ring *B* is held in the die bed by three set-screws, as shown in the drawing. The stripper ring has a little play in its chamber, to be able to expand when the shell is pressed through. The punch-holder, Fig. 8, was made of machine steel with a suitable hole to receive the punch. The punch proper was turned to size and an air hole put through it, then hardened and ground.

Operating the die was as follows: The shell to be sized was stuck on to the punch, and when the treadle of the press was tripped the shell went through the die and a little below the stripping ring, which would close up around the punch by the action of the spring and strip the shell off the punch when it returned. Fig. 11 is a sizing die for the small part of the shell. The die is made with a bottom to lift out, as shown by the drawing. Operating the die was the same as on the first sizing die. The shells were stuck on to the punch, and after they were sized they came off nicely. The ends of the shells were trimmed on a trimming lathe. The shells, of course, were annealed between the operations.

The most interesting feature of the drawing of such shells is the stretch that the metal will stand under the strain. In this case the blank was 3¾ diameter, and the shell measured 7 inches from one bottom edge to the other, so the blank was stretched to about double its former diameter; but this will make another story.



THE LAST THREE OPERATIONS

Unfair to Technical Schools

By W. Alton

Is it not about time to stop "roasting" the technical schools and give them a little credit for doing as well as they do, considering the quality of much of the material they have to make into engineers?

No one can be more conscious of the shortcomings of the average "tech" when he first goes to work than I am; but it must be remembered that the schools have to take whatever material comes to them. If they could have their choice of material, no doubt the resulting product would be quoted higher in the market.

At the same time, given equal intelligence to start with, I believe that the technical man will usually be more valuable than the one from the shop, after he has been at work long enough to be able to apply his knowledge intelligently.

Anyone who has had to do with hiring mechanics knows that the product of the shops is not all first class, and that where one really capable man applies for a job there are many who can never be depended upon to do anything right. No one would assume to judge of the product of the shop training by the last-named specimens, and the same rule should apply in judging the men from the schools. This is particularly true as the shop can select its material, to a certain extent, while the school has to take anyone who can pass the entrance examination and pay the fees.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

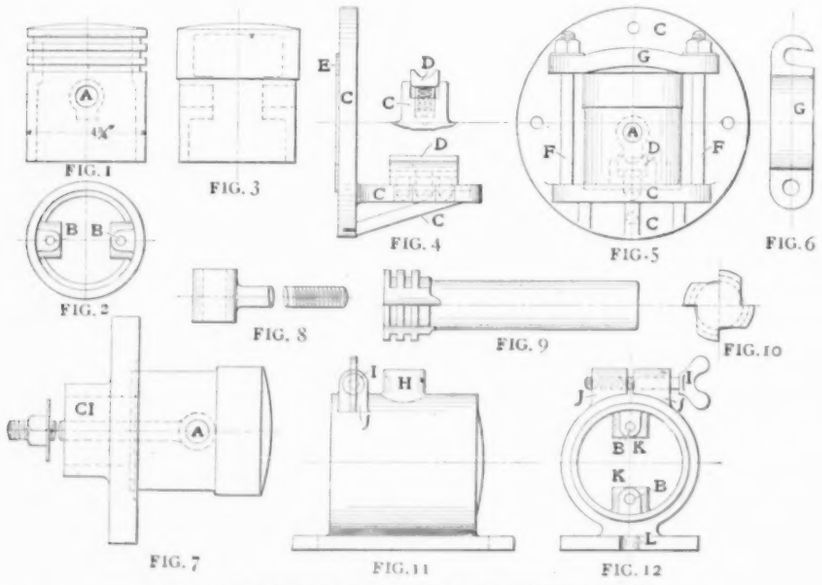
WE PAY FOR USEFUL IDEAS

Jigs and Fixtures for Machining Automobile-engine Pistons

The sketches show a complete set of jigs and fixtures for machining pistons for a 35-horse-power automobile engine. These pistons are made out of a good-quality, close-grained, gray iron, and are shown in Figs. 1 and 2, and also, in a partly finished state, in Fig. 3. They are turned complete, and the wrist-pin hole bored in a flat turret lathe, with a cross-sliding headstock.

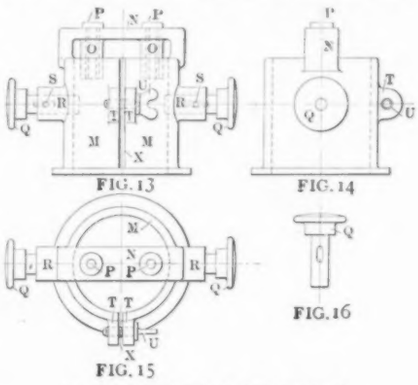
The first operation is to grip the pistons at the top, or solid, end in the four-jaw chuck supplied with the lathe, face them across the bottom end, and turn them over the top as far as the chuck jaws, leaving 0.010 inch to finish by grinding. The piston now takes the shape as shown at Fig. 3. The next operation is to bore the wrist-pin hole, marked *A*. For this operation the gray-iron face plate *C 1*, shown in Fig. 7, is clamped on to the lathe spindle, turned up, and recessed on the front to receive the spigot *E*, turned on the back of the angle bracket *C*, shown in Figs. 4 and 5, and secured to *C 1* by four 5/8-inch set screws. *C* is recessed out 1/8 inch deep on the bottom, to receive the turned end of the piston, which should be a good fit and located central with the lathe spindle. To insure the wrist-pin holes being exactly central, a lug is cast on *C*, which is shaped out to receive the steel-locating slide *D*. The latter has a turned shank, which drops in a hole bored in *C* to receive it, which has also two 5/4-inch holes drilled in 3/4 inch deep, as shown dotted in Fig. 4, for receiving two springs made of 16-gage steel wire, for forcing *D* up to the wrist-pin hole lugs, cast inside the cylinder. These lugs locate themselves in the V planed in the top of *D*, to insure the pin hole being bored dead central in them. *F F* are two 5/8-inch bolts, and *G* a swinging clamp, for securing the piston while it is being operated on. Fig. 6 shows a plan of the swinging clamp, which is curved on the inside to fit the crowned top of the piston.

The next operation is to complete the turning. For this operation a recess is turned in the face plate, as shown at Fig. 7, into which the turned end of the piston is a good fit. To insure its running true, an eyebolt, shown separately in Fig. 8, is passed through the hollow spindle of the lathe, a pin is pushed through the piston and eyebolt, as shown, and the lot made secure by the nut and washer at back; the front crowned end is then faced up with a simple form cutter, and the remaining portion of the top finished to the same size as the other end. The three ring grooves for the piston rings are then turned in by the form tool, shown in Figs. 9 and 10, all at the same time. This tool has a round turned shank, and is held in a bush in the turret; it has four cutting edges milled in, as shown in Fig. 10, two being for roughing and two intended for finishing. This completes the turning operation.



JIGS AND FIXTURES FOR AUTOMOBILE-ENGINE PISTONS

The next operation is to face the inside of the two bosses *K* to width, as shown in Fig. 12. In the jig shown in Figs. 11 and 12, this is planed on the bottom and bored out to receive the piston, and a saw cut 1/8 inch wide milled along the top, the lugs *J* being drilled and tapped for the thumb screw *I* for holding the pistons in position. The cutter bar passes through the lug *H* and through the wrist-pin hole in the piston; a double-ended face-milling cutter is slipped on, and the bosses faced to width. Two slots *L* are cored in the bottom of the jig for holding-down purposes.



JIG FOR WRIST-PIN SET-SCREWS

The next and last operation is to drill the two set-screw holes *B* for securing the wrist pin in position. For this the jig shown in Figs. 13, 14 and 15 is used, being bored to fit the piston, and sawed through at *X*. As in the case of Figs. 11 and 12, the two lugs *R* are bored out to receive the two locating pegs *Q*, which locate the piston by passing into the wrist-pin holes; the thumb screw *U*, operating through the two lugs *T*, which are cast solid with *M*, is used for securing the lot; *S* is a 3/16-inch round pin, which passes through *R*, and operates through a slot in *Q*, as shown in Fig. 16. We found this preferable to a spring plunger. When the pin *Q* is pulled back to the end of the slot the piston can be removed from the jig. When the shoulder of *Q* is pushed up against the faced end of *R* the piston is located in position for drilling. For this the top cross bar *N* has two bosses *O* cast on it, projecting down the inside of the piston and carrying the two drill bushings *P*. Thus the top of the jig is open for the operator to look through and see the drill at work.

Pistons machined with this set of jigs can be done in the minimum time, at a great saving in labor cost, and they are absolutely interchangeable, which means a lot in assembling.

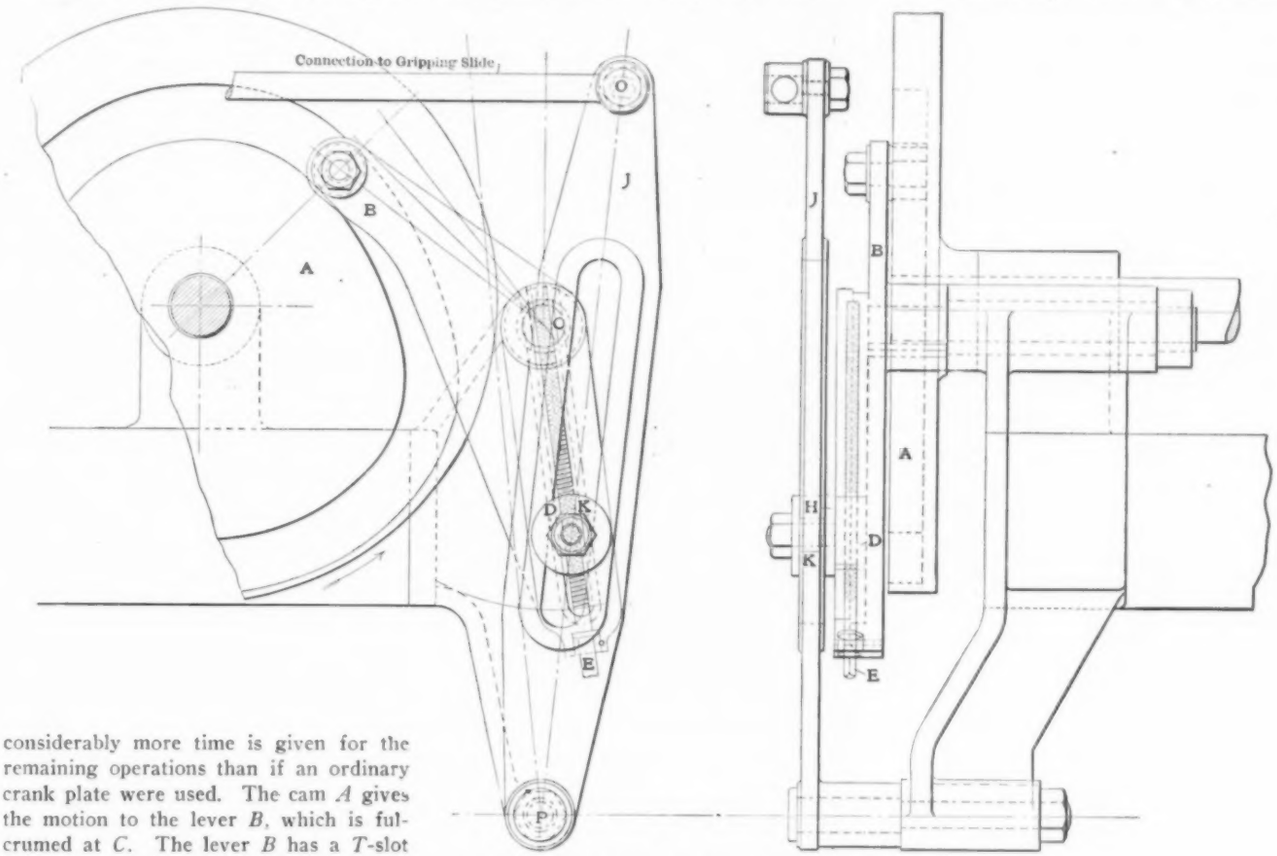
"AUTO."

England.

An Adjustable Cam and Lever Feed

I send you a layout of an adjustable cam feed for use on a wire-forming machine or any automatic machine on which sheet-metal strips or wire from the coil is used. The features of the feed are, first, the great range of adjustment (the one in the sketch here shown having an adjustment from nothing to 5¾ inches); secondly, it will work as quickly as it is possible for the cam to give the desired movement, usually from 60 to 90 degrees is sufficient. By feeding in 90 degrees considerably more time is given for the remaining operations than if an ordinary crank plate were used. The cam *A* gives the motion to the lever *B*, which is fulcrumed at *C*. The lever *B* has a *T*-slot in which the block *D* slides, and is adjusted by the screw *E*. Integral with the block *D* is a stud and on this stud a shouldered bushing *H* is placed, which should be a good running fit. A sliding block *K* is a running fit on the bushing *H* and also in the slot in the rock lever *J*, which is pivoted at *P*. At the end of the lever *J*, at *O*, is a connection by means of which the movement of the lever *J* is transmitted to the gripping slide. The points *C*, *P* and the central position of *O* should lie in the same straight line.

When the center of the stud on the block *D* coincides with the point *C*, the center of the block *K* will also coincide, and the lever *J* will be stationary. This is one extreme. Now by adjusting the sliding block *D* toward the head of the screw *E*, we can regulate the throw of the lever *J* to any point within the limits for which the feed is designed. By this method a crank motion or any desired motion can be given so that the lever *J* will work smoothly. I have seen this feed movement used, and I have used it myself on several machines. It is very accurate and gives good satisfaction. FEED.



AN ADJUSTABLE CAM AND LEVER FEED

Annealing High-speed Steel

I do not know where E. V. gets his idea that Novo or any other kind of high-speed steel needs such elaborate apparatus to heat it. There are several ways of telling what is meant by 800 degrees Centigrade, or dull cherry red, without an elaborate apparatus. Lead will boil at 815.5 degrees Centigrade, and it will not cost much to try it and learn the color.

I would not want to heat in ten to twenty minutes, as he states, any piece of carbon steel that was intended to be for a tool. Manufacturers of high-speed steel say it *must* have more time than carbon steel to heat for annealing. I have often had three or four hundred pieces to anneal, and if I had to make sure they were drillable, as E. V. says, I would have little time for annealing and hardening. I am through with using water when it comes to high-speed steel.

The manufacturer of today wants his lathe tools to cut steel running from 150 to 190 feet per minute. He wants his milling cutters to run from 90 to 160 feet per minute, and he does not want to have them ground oftener than from 6 to 14 days, and the latter is much preferred. If E. V. will convince me that he is obtaining these results, then I will consent to get a pail of water and try his suggestion.

I can hardly think that S. I. W. is still in trouble if he is following my directions at page 322. Of course, if E. V. has only one piece to anneal and he has hardened it as he advised me to try, he may be able to anneal it; but let me ask him to try something. Take some ⅝-inch round stock, pack just as he has described in a vessel one inch larger than the piece to be annealed, heat it for 10 or 15 minutes, then take from the fire and open to see how hot it is. He will find that the piece has reached only about 700 degrees Centigrade, for he could get his caps only to a little more than a yellow orange, or 1200 degrees Centigrade, and, using the forge he does, he can hardly work his fire to 1200 degrees Centigrade, and do his work carefully.

As I stated in my previous article, a piece of high-speed steel could be heated for one hour and might be soft or it might not. If the piece had not received the proper heat when it was being hardened, then it might be annealed; but that is not the heat to harden at. Hence we term the piece "tool hard," as it can be machined, but not hardened as a tool to do work, so we cannot consider the annealing of such hardening. I have had thou-

sands of pounds of high-speed steel to anneal, and when the methods are used as stated before, the results have been very satisfactory.

In shops where lead bath is used, the lead will be found an excellent place for annealing small work by placing the steel in the hot lead, leaving there over night, taking out when the lead is reheated, removing lead from the work with a wire brush or by dipping the work in oil, then in the lead bath, thereby removing all lead stuck to the surface of the work.

If these pieces are small and the body of the lead sufficiently large to hold heat for a number of hours, it will not be necessary to heat the lead more than 800 degrees Centigrade, dull cherry red; neither will it be necessary to run the fire to continue the heat after the work is put in. C. U. SCOTT.

Herring-bone Gearing

A gun-boring lathe is directly driven by a 40-horse-power motor through metal

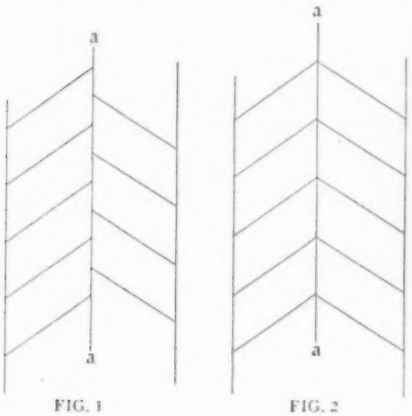


FIG. 1 FIG. 2

THE TWO GEARS

herring-bone gearing. Each gear is made in two parts bolted together on the line *a a*. A asserts that in order to obtain a noiseless drive it is necessary to stagger the teeth of the gears as in Fig. 1, while B is of the opinion that it is wrong to stagger the teeth, stating that the teeth should be as at Fig. 2. As the motor runs at a slow speed the lateral pressure induced by the angular teeth is neutralized by having the teeth arranged as at Fig. 2, while with them arranged as at Fig. 1 there would be a tendency for the gears to slide on end alternately in either direction. HANS BUNGE.

Chemnitz, Germany.

[Herring-bone gears are commonly made in this country as shown in Fig. 2 and they run with very little noise if well made. Fig. 2 has the advantage of a reduced effective pitch but we should expect good workmanship to be even more important with this construction than with the other. We are unable to say which plan is preferable.—ED.]

A Multiple Pattern

The half-tones and sketch show how four pipe elbows were made in one pattern. A half pattern only was needed as it was molded on the machine, both halves of the mold being alike. Fig. 1 shows the

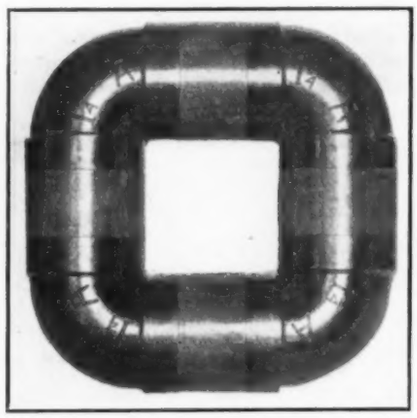


FIG. 1. PATTERN FOR FOUR PIPE ELBOWS WITH THE CORE PRINTS

FIG. 2. BACK OF THE PATTERN

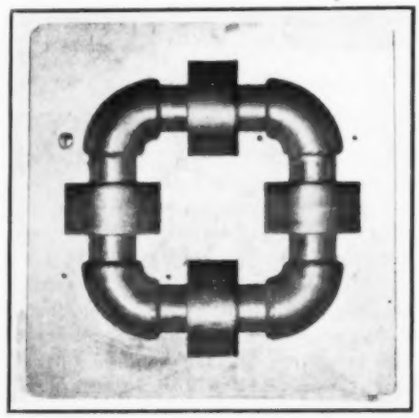


FIG. 3. THE CORE IN THE CORE BOX

pattern, the light portion being the print. Fig. 2 shows the back of the pattern and how it was cut out for screws to hold the joints. The straight parts were turned in halves, and the four corners if brought together would make a complete circle, which will explain how these were turned. Fig. 3 is a picture of the core box, although it shows the core more than it does the box. Fig. 4 shows the core in relation to the four castings. This multiple pattern took but little more flask room than a single pattern would, as a single pattern would require longer prints. The combined core being supported in four places needed no anchors to hold it in place, resulting in four castings being molded as quickly as one could be, the result also being surer. J. L. GARD.

Dimensions on Drawings

I have lately been following with considerable interest the correspondence appearing in these columns, under the above heading, on account of having from time to time felt the difficulty of expressing in writing on a drawing the exact degree of accuracy required for the particular work in hand.

On page 290 H. D. Penny mentions that it is his custom to use vulgar fractions in dimensioning unimportant sizes and decimals for those which are important.

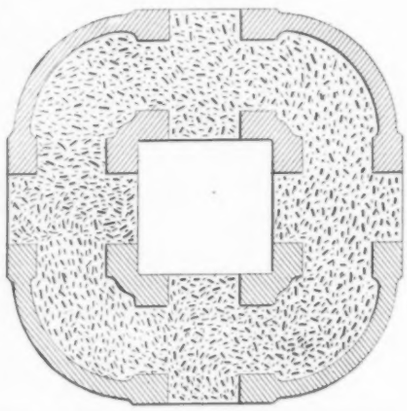


FIG. 4. THE FOUR CASTINGS AND THE CORE

He gives the reason for this as being that it would be a simple matter to machine a piece, say, to 1 5/16 inches; but to machine a piece to 1.3125 inches would involve considerable skill on account of the accuracy demanded by the latter dimension. But the two are identical, and why should a decimal dimension imply more accuracy than when vulgar fractions are used? Of course I can imagine the system being used when all of the machinists are acquainted with it; but men are continually coming and going, and before a new hand knows the difference in accuracy required he may spoil work which has had considerable time expended upon it. An explanatory note on the drawing could be used to explain the different degrees of accuracy required in the two kinds of dimensions; but even then it seems to me to be a quite unnecessary mingling of the two systems, requiring the use of tools graduated to suit both the decimal- and the vulgar-fraction dimensions.

Where I am at present engaged all dimensions are given in millimeters, so that it would be hardly possible to use the two systems, and the method I adopt is to underline thus (3.45) all dimensions requiring any considerable degree of accuracy.

A footnote on the drawing explains the use of the line. If very great accuracy is required, limits are added, as

$$\left(3.45\ {}^{+\ 0.002}_{-\ 0.000}\right).$$

This system, I believe, is quite common.

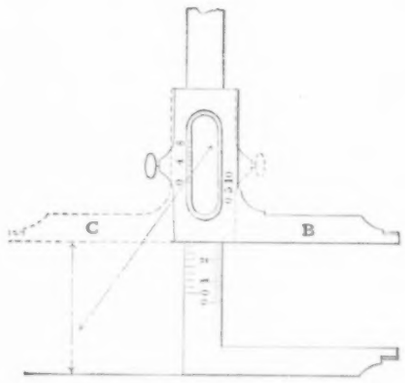
When a drawing is nearly completed and it is required to alter the dimension of a part which would involve considerable rubbing out and redrawing, if made to scale to the new dimension, I simply put a line over the figures, thus $(\overline{3.45})$.

On the subject of keeping a record of jig drawings I should like to say that my experience certainly shows, to my own satisfaction at any rate, that it is better to retain the original drawing of the jig in the office and to issue one or more blue prints to the various departments. Otherwise difficulties sometimes arise when a figure has become indistinct or invisible, as there is no record at hand of that particular dimension. Again, drawings *do* get lost sometimes, in which case the whole thing will probably have to be redrawn. This applies chiefly to large works, and no doubt in a small factory a modification might prove to be an advantage. E. J. L.

London.

A Swiss Vernier Caliper

The illustration shows a vernier caliper of Swiss manufacture. It is graduated on both the inside edges to metric measurement and on the one outside edge to English inches and eighths.

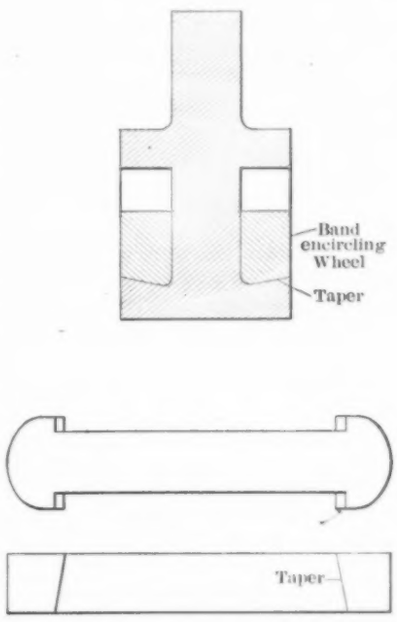


A SWISS VERNIER CALIPER

By reversing the sliding jaw to the position *C* it can be used as a hight gage, an extra set of vernier graduations being provided on the sliding jaw for hight-gage readings. H. Frey.

A High-efficiency Fly-wheel Joint

While not wishing to detract from the appreciation given Mr. Haight for his improvement, there remains a practical defect which seems to me a real one. This is that no provision is made to prevent the steel links (the feature of the design) from possible sideway movement. This movement seems possible, and it is therefore desirable to provide against it.



LINK AND BAND FOR FLY-WHEEL JOINT

No doubt when used as a Pelton wheel the casing can be so designed as to eliminate this objection, but the suggestion of the article is for its use as a fly-wheel.

Although not stated in the letter-press it is obvious that the link is shrunk in, and under these conditions it is quite possible to impair its tensile strength by an excessive shrink allowance.

The calculated stress given for the link is 8800 pounds per square inch, and a safe working load would be say 15,000 pounds per square inch. Using Young's modulus, the amount of stretch necessary to produce this would be 0.0065 inch.

Stress $= E \times$ strain.

15,000 $= 30{,}000{,}000 \times$ strain.

Strain $= \frac{1}{2000}$.

Stretch $= \frac{1}{2000} \times 13 = 0.0065$ inch.

Taking this as shrink allowance, an excess of 6200 pounds is available to hold the link in place under normal load.

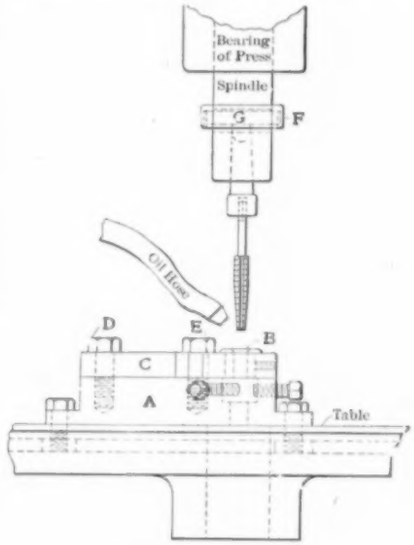
But, right here, another point suggests itself. Will the steel of the link alter in elastic value under the varying stresses occurring with normal or possibly abnormal loads? It is possible that it will do so, and from this point of view a safeguard against side movement seems necessary. One solution of this would be lugs cast on the wheel with a cotter driven through them, but projections of this character are objectionable in several ways.

It may be possible to put in the links so that the taper shown in sketch (exaggerated) will hold the links from sideway movement. As a better but more expensive solution banding the wheel in the groove would seem a simple method of retaining the points of the design. Such a wheel would be considerably stronger than a solid casting, and a better shrink job could be made. A. L. Haas.

Tapping Nuts Rapidly on the Drill Press

Having a great many nuts to make of varying sizes, from ¼ to ¾ inch, mostly of a special thread, the drill press was used advantageously with the fixture shown. The body *A* of the fixture is of cast iron 3x2½x6 inches, with a 13/16-inch hole drilled all the way through and counterbored 1½ inches diameter and 1 inch deep. Two ½-inch set-screws of ample length for all adjustments were put in 120 degrees apart and at the center of the depth of the counterbore.

These screws clamp the blank nut and bring it central under the bushing *B*. It is only necessary to use one screw after the first nut has been set. The bushing *B* is carried by the piece *C*, which pivots on the bolt *D*, allowing the removal or insertion of the work. *C* is cut out on one side for bolt *E*, which clamps it when in working position. It also acts as a stop. *B* is held in place by a set-screw so as to allow for changing to any desired size. *A* was clamped over the hole in the press table and brought central with the spindle.



NUT TAPPER FOR DRILL PRESS

A Novel Collet Ejector

The press was arranged so it would be unnecessary to stop to change from drill

to tap, or the reverse, by means of the collar E, which was a loose sliding fit to the press spindle and milled for a tool-steel piece G, shown dotted, which was a loose fit in the slot of the spindle. This slot was elongated to allow for B being heavy enough not to bend and so G would not interfere with the tang of the collets.

With this arrangement it was only necessary to let the collar F strike the bearings of the press to eject the collets. In fact, I added sufficient weight to the counterbalance of the press to make this operation automatic, by setting the trip of the feed. The collet was made a loose fit for the shank of the tap so the tap would drop out when it was through the nut.

The taps were made longer than the ordinary tap and were run through at the same speed as the drill. A pump was borrowed from an old Brown & Sharpe miller and driven from the feed cone of the press, giving a fine cooling stream of cutting mixture. With this arrangement and an apprentice we drilled and tapped thousands of nuts rapidly and accurately.

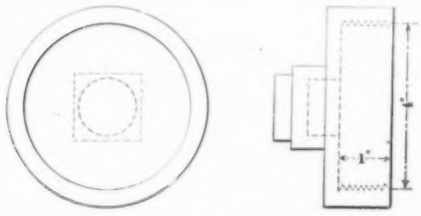
JOHN J. SEIBERT.

When Does It Pay to Make Special Tools?

We make about 300 caps per year like sketch. The usual method was to face edge and bottom, bore and thread on turret lathe; time, 18 minutes.

We made a reamer and tap for this, and now face edge and bottom, rough-bore, then ream and tap; time, 9½ minutes.

The cost of tap and reamer was $19.



THE CAP TO BE MACHINED

The saving in one year is $7.43 in time, as a handy man runs this machine.

As the tools have actually done the first year's work, or 300, and are in a condition that promises 300 more, the up-keep has cost but the interest on the investment the first year.

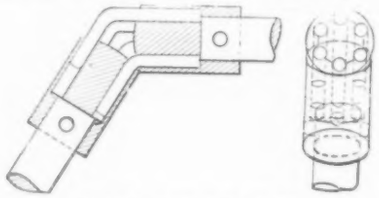
In a discussion over the tool the superintendent said that it did not show margin enough to provide for accidents, operator's lack of judgment, hard material, etc. The waste steel from a bolt cutter furnishes steel for insertions for tap. The reamer has inserted teeth of high-speed steel. The teeth in both reamer and tap can be replaced for $5.

So I would be glad to know what readers of AMERICAN MACHINIST think pays along this line. R.

A Simple Flexible Joint for Small Power

The sketch of the joint shown here will be found to be very convenient and economical where it is desired to transmit power at an angle.

The power is transmitted in the same manner as with a straight shaft. The difference is that, as the shaft revolves, the



SIMPLE FLEXIBLE JOINT

distances between the holes of the holders change, and the pins, by sliding up and down, span these changing spaces.

F. R. C.

Authority of Gang Foremen

I have observed in several shops the practice of subdividing the work, each part being under the direction of a gang boss or sub-foreman. I believe this system is the most economical method of producing work in large quantities.

Having had more or less experience under the various ways I would like to call attention to several defects or weak spots coming to my notice.

The first, and greatest, is lack of authority on the part of the sub-foreman. He is given charge of a number of men and told that he will be held responsible for the quality and quantity of the work produced, also for the general discipline of his help.

Upon trial it is found that one or two of his men are entirely unsuitable for the class of work. After fifteen or twenty dollars' worth of material, to say nothing of time, has been wasted, complaint is made to the department foreman. The answer is: "Well, can't you change them! Give them some rough work to do."

Again, the sub-foreman has a job to be done in a hurry, and thinks he will give it to Tom. Looks for him, but he is not to be found. Upon making inquiries of the clerk the reply is: "Oh, yes; Tom asked in the office to be allowed off the rest of the day."

After a few more experiences like the preceding, Mr. Sub-foreman begins to doubt his authority. He finally decides his position is simply that of a driver, and desiring to be somebody or nobody, he resigns in disgust.

I have found that the only way to make a success of dividing work is to give the man in charge of it absolute authority over the men under him; listen carefully to complaints about tools, and suggestions as to methods. Treat your assistant as a man, not as a machine, and if he is the man for the place he will respond.

Do not, upon any consideration, step between him and his help. If a workman comes with complaints, tell him that if he can't get along with his foreman he will have to go.

Another thing: be frank; do not try to make your assistant believe that every job he has under way is a hurry job. If he is a man of intelligence he knows better; if he is not, you do not want him.

If this system does not work, change your assistant and do it quick.

The foregoing is only an old friend under a new form, namely, the straw boss. But there are so many places where it is practised that I am impelled to write, hoping that it may come under the eyes of some of the powers that be, and conditions be improved thereby.

CO-ORDINATE.

Centering Round Stock in the Sensitive Drill—Another Centering Scheme

I was reminded by Mr. Faulkner's description of his centering device for the sensitive drill, at page 563, of an old method which I once saw used—not, however, in the sensitive drill, but in the speed lathe. The device consisted of a cone-shaped driving piece or chuck, as shown in Fig. 1, and two V-rests like Fig.

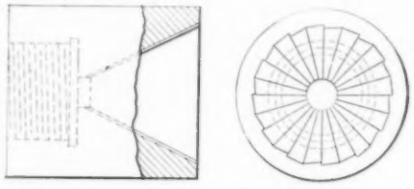


FIG. 1

FIG. 2

CENTERING ROUND STOCK

2 The chuck was made of machinery steel and fitted to the thread on the lathe spindle. Its internal surface was cut lengthwise toward the center, with teeth for the purpose of driving the stock. To preserve the teeth they were case-hardened. Two case-hardened V-rests provided with shanks of sufficient length to allow of a variety of sizes of stock were fitted to two hand rests, such as are usually furnished with speed lathes.

To use the device, the chuck was screwed on the end of the lathe spindle, one rest was placed as close as possible to it, and the other at a distance away, depending on the length of the stock to be centered and drilled. The combined drill and countersink was carried in a chuck in the tailstock. The rests were adjusted to the

proper hight for the diameter of the stock to be drilled, a length of stock put into them, and the lathe started. The pressure of the drill in advancing toward the headstock drove the stock into the chuck and caused it to rotate. The continued pressure of the drill of course accomplished the desired result. This method of centering and drilling is a very rapid one, but I am unable to say how it compares in rapidity with that described by Mr. Faulkner. It seems to me, however, that this device would cost somewhat less than the one described by him. L. A. M.

A Few Notes about Helical Springs

Your recent articles on springs ought to be of great service to many engineers who have experienced a difficulty in designing springs. Although it seems a very simple matter designing a spring, yet the number who fail to do so correctly is appalling. In the course of a few years spent in the drawing offices of some leading engineering firms in the north of England I have worked beside a large number of draftsmen, and yet the number who knew anything about a spring could be counted on the fingers of one hand.

A Caution to Designers of Springs

When making a drawing of a spring I always made a scale diagram similar to Fig. 1 in O. A. Thelin's article, page 847, Vol. 29, Part 2. It will be noticed that the distance between the vertical lines (Fn—f'') in the diagram referred to gives the working movement. It is here some draftsmen on boiler work go wrong. They take the blow-off pressure of a safety valve as the P of the formula, forgetting that they are, by thus doing, not allowing for any working movement. When the valve lifts, a greater load and extension or compression, as the case may be, than the spring was designed for comes on it. Perhaps the Board of Trade foresaw this when it produced the formula used by marine engineers, using a coefficient 8000 for round steel in place of 31,500 given by Thelin and 35,000 used in Elswick.*

$$\left.\begin{aligned} P &= \frac{35{,}000\ d^3}{D} \\ F &= \frac{0.02333\ D^3}{d} \end{aligned}\right\} \text{for round steel,}$$

$$\left.\begin{aligned} P &= \frac{10{,}000\ d^3}{D} \\ F &= \frac{0.015\ D^3}{d} \end{aligned}\right\} \text{for brass wire.}$$

in which, as in Mr. Thelin's article,

*The Armstrong works, described in the American Machinist in 1904.—Ed.

The Elswick formulas are:

P = force in pounds,
F = deflection in inches of one coil under load P,
d = diameter of wire in inches,
D = pitch diameter of coil in inches.

How the Spring Formulas are Developed

Your correspondent, Mr. Thelin, remarks that the formulas of a helical spring are based upon the fact that the coil in a spring can be treated as a bar, held at one end and influenced by a turning moment at the other, the arm and force of the moment corresponding respectively to the pitch radius and load of the coil. Perhaps the following may be of interest to those who would like to trace the formulas from the first principles:

$\frac{D}{2}$ = mean radius of the spring.
Z_t = modulus to resist torsion.*
f = stress in pounds per square inch.
θ = angle of torsion (expressed in radians, not degrees).

Equating moments,

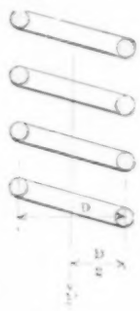


DIAGRAM ILLUSTRATING MOMENT OF FORCE ACTING ON SPRING

$$P\frac{D}{2} = f\,Z_t\ ;$$

$$\therefore\ P = \frac{2\,f\,Z_t}{D} = \frac{2\,f}{D} \times \frac{\pi d^3}{16}.$$

In the Elswick formula f is taken as 89,250, and the formula thus becomes:

$$P = \frac{2 \times 89{,}250}{D} \times \frac{\pi d^3}{16} = \frac{35{,}000\ d^3}{D}\ \dagger$$

The general equation for stiffness in any case of torsion is

$$\textit{Moment of force} = \frac{\theta}{l}\ A, \text{ where}$$

l = length of material twisted, and
A = torsional rigidity = modulus of elasticity for torsion × polar moment of inertia. (The proof of this may be found in works on analytical mechanics.) From this, inserting $P\frac{D}{2}$ for the moment, and solving for θ, we get:

$$\theta = P\frac{D}{2} \times \frac{l}{A}.$$

Approximate length of one coil $= l = \pi D$. Substituting value of l:

$$\theta = \frac{P\,D}{2} \times \frac{\pi D}{A}.$$

Deflection F =

$$\frac{D}{2}\theta = \frac{D}{2} \times \frac{P\,D}{2} \times \frac{\pi D}{A} = P\frac{D^3}{4} \times \frac{\pi}{A}.$$

A for round section $= G\frac{\pi d^4}{32}$, and by substituting this value:

$$F = \frac{P\,D^3}{4} \times \frac{32\,\pi}{G\,\pi\,d^4} = \frac{8\,P\,D^3}{G\,d^4}\ *$$

G is taken as 12,000,000 in the Elswick formula and we get for F, by substituting values for P and G:

$$F = \frac{7}{300}\,\frac{D^3}{d}, \text{ or } 0.02333\,\frac{D^3}{d} \text{ per coil.}$$

The values of $\frac{A}{G}$ and Z_t for the various sections may be obtained from tables of polar moments of inertia and polar section moduli.

A Few Other Formulas

One eminent firm of engineers uses:

$$P = \frac{26{,}880\ d^3}{D} \text{ and } F = \frac{0.0214\ D^3}{d}$$

for steel, and

$$P = \frac{16{,}128\ d^3}{D} \text{ and } F = \frac{0.0214\ D^3}{d}$$

for brass.

This same firm had a curious safeguard (?) which took the form of the formula:

$$\frac{\textit{Load in hundredweights} \times \textit{Maximum extension}}{\textit{Weight of spring in pounds}}$$

must not exceed 10.

I won't explain it, but let those who would enjoy a smile do as I did and substitute. T. R. C.

England.

[It will be apparent that Begtrup's ("Kent's") formulas, Thelin's formulas, and the Elswick formulas, given in the above article, are all based upon the same scheme of development, such as that presented herein.—Ed.]

*Or the $\frac{\textit{Polar section modulus}}{\textit{Distance of extreme fiber from center of gravity.}} = \frac{\textit{Polar moment of inertia}}{\textit{Distance of extreme fiber from center of gravity.}}$

†The coefficient is, more exactly, 35,048.

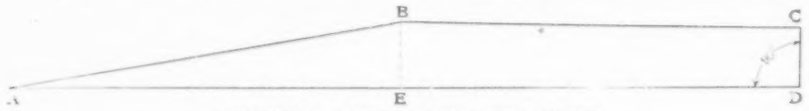
Wanted—Fool-proof Gages

I would very much like to hear of a shop gaging system that is practically fool-proof, and which will stand the abuse usually resulting from the use of the "premium plan." I have encountered lots of trouble with snap gages being badly sprung, and ring gages lapped out, by trying on revolving shafts, etc. I would like to know how some of the other boys have fared in this connection, and what method they have adopted to prevent or nullify such treatment. Gage.

*The same as Thelin's first expression for F.—Ed.

A Problem in Laying-out a Gear Train

In the course of one's daily work one runs across many novel and interesting problems that have to be solved—some that may be attacked by authorized rules,



A PROBLEM IN LAYING OUT A GEAR TRAIN

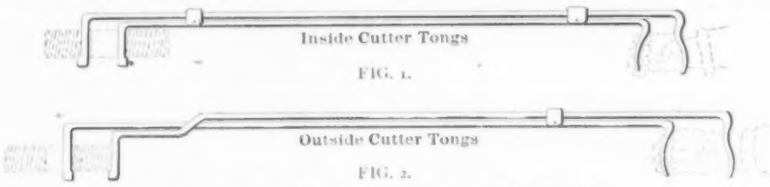
others that require some ingenuity in their solution. The latter are those that add interest to the routine work in hand.

I have very often run across problems similar to the following example: We have a train of three gears located as suggested by the sketch, where *A, B,* and *C* are the centers of the gears. It is required to find the hight above the line *A D* of the center *B*, that is, the length of the line *B E;* the known dimensions being *A B* and *B C*, each equal in this case to 3.4 inches, though their equality is not a necessary condition of the general case; and *A D* and *C D*, which are, in this example, equal to 6¾ inches and ½ inch, respectively.

I have in each case solved the problem so as to come to a satisfactory result, but the methods employed have been anything but satisfactory. I should therefore like to submit the problem in order to see what can be made out of it in the way of a satisfactory solution. In most cases where the dimensions are so proportioned that the angles are large the problem might be solved graphically, but in the case mentioned nothing but a mathematical solution would give a very satisfactory result. DYNAMIC.

Tongs for Handling Cutters in Gas Furnaces

In handling high-speed milling cutters, formed screw-machine cutters, and also small dies in the high-heat gas furnaces, it is necessary to have tongs capable of



TONGS FOR HANDLING CUTTERS IN GAS FURNACES

holding the work with an even, but not severe pressure. The sketch shows an inside and also outside tongs made for use in a furnace having a comparatively small entrance. Either kind can be made from ⅛- or ½-inch iron in a short time. With this kind of tongs, there is no danger of springing the work by too much pressure, as the pressure is applied directly in proportion to the strength of the grip on the handles. DON W. KING.

Molding a Worm Wheel in a Two-part Flask

When a boy, about 20 years ago, I saw an old gray-haired molder demonstrate several ways of molding a sheave wheel in a two-part flask, all of which, he said, were in common use when he learned his trade. These were as follows:

In Fig. 1 the drag half of the pattern was laid on the mold board and the drag flask, which had been well clay-washed, rammed up, packing sand firmly against the sides. The parting was next made to pattern, along lines *E E*, and the balance of drag rammed; the whole rolled over, cope pattern put on, throat of sheave rammed and parting made along lines *F F*, the cope placed, rammed and lifted off,

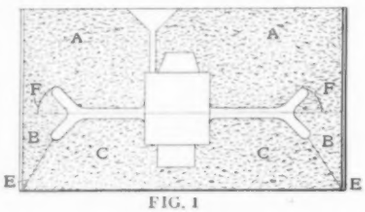


FIG. 1

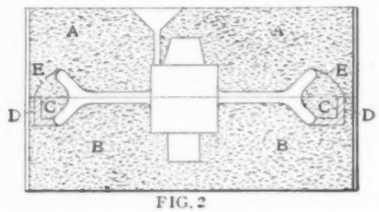


FIG. 2

TWO WAYS OF MOLDING SHEAVE IN TWO-PART FLASK

the top half of pattern drawn and the drag lifted off the bottom board, carrying sand as shown at *B*, and leaving drag pattern and sand, shown at *C*. The pattern is next drawn, core set, nowel replaced and cope closed, all of which, as the sheave was only 10 inches diameter, required less time than the telling of it.

ANOTHER WAY

In Fig. 2 an iron ring *D D*, about ½ inch larger in diameter than the pattern, was placed on the mold board with the drag pattern, the drag rammed and rolled over, cope pattern placed and throat of sheave rammed, parting made as shown by lines *E E*, cope rammed and lifted off, cope pattern drawn, iron ring carrying sand, as shown by *C C*, lifted out, drag pattern drawn, core set, ring replaced, cope closed and weighted ready to cast.

The third method was substantially the same as that described by L. J. Yeomans, while in the fourth, dry-sand cores were used to form the throat of sheave.

REPAIR-JOB CASTINGS

One can't avoid thinking that if the performance quoted above was such a surprise to "his tormentors," that theirs would be a very undesirable foundry to handle some of the break-downs that so often tax the ingenuity of foremen and molders, who are frequently called upon to devise ways and means to replace broken castings in a hurry, and with only such help from the patternmaker as is absolutely necessary to enable them to cast it today. L. N. PERRAULT.

An Emergency Method for Straightening Pipe

There are very few jobs that may not be done in more than one way. Pipe straightening is one of them. I once found myself with several lengths of four-inch wrought-iron pipe which were not as straight as I considered necessary. To straighten them I roped the lengths tightly between two wooden scantlings, and wet the ropes. As the ropes contracted they drew the scantlings together and made the pipe somewhat straighter. When they stopped shortening I bound other ropes about the entire rig, between the wet ones, and after wetting them, removed the first set. A third set of ropes, wet in like manner, made the pipes straight. ROBERT GRIMSHAW.

Turning Ends of Square Bars

I think John Price, at page 538, must have had some trouble turning the ends of square bars with a box tool containing four cutters.

Some years ago I ran across a job where they had them to turn by the thousand. My predecessor turned them on centers. I fixed a tool similar to Mr. Price's. When I got it started the fun commenced, there being four cutters. All four cutters were in the heavy cut or the light cut at the same time; consequently there was a decidedly jerky motion of the belt and lathe spindle.

I changed the tool so as to use five cutters, which stopped the jerky motion, because one cutter only was in the heavy cut at a time. Some one of the five was in the heavy cut all the time, while the others were leaving or commencing the heavy cut, or in the light cut. After the

job was set up a boy could turn out ten times as many as a man could in the old way. W. A. BRIGHT.

A Set of Curling Dies

In Fig. 1 is shown a set of power-press tools for double curling the tin blank, Fig. 2. The tin is about 0.016 inch thick. The blanks are afterward bent into handles for hand lamps. Block *A* is of gray iron, planed through for the steel blocks *B*, *C* and *D*. The semi-circular grooves are cut on the extreme edges of the blocks. The bottom one *B* is slightly rounded at the edge to remove the sharp corner at the outside. Parts *C* and *D* are planed narrower than the groove in *A*, so as just to admit the blank. The end view shows the blank in position ready for curling. *B* is hardened along the grooved side and polished. It is fastened to *A* in the manner shown in the section. *C* and *D* are left soft and are a sliding fit in *A* when the blank is put in. The two screws *E* control the upward movement of the top block *D*, which is forced up by the three springs, the screws being adjusted till *D* is held at the proper hight from *B*, so that the blank after the second operation is easily slid in endwise. The wire is then placed in position. The holes in *C* are drilled an easy fit for the springs and screws *E*. The upper holder *G* is of gray iron, with the tool-steel portion *F* fastened to it by screws. The latter is hardened along the grooved part and polished.

The ledge on *F* is to give the needed support to the back of the blank while it is being curled. When the part *F* is receding after the curling operation, the three springs cause the block *D* to follow it as far as the screws *E* will permit, the curled blank lifting the die *C* also. After the blank is removed, *C* drops by its own weight to the bottom, ready for the next blank. The wire is 0.125 inch diameter. The full diameter when curled = 0.158 in. The length of the wired part of the blank is 9½ inches. These dies have never given any trouble whatever.

Birmingham, Eng. W. REYNOLDS.

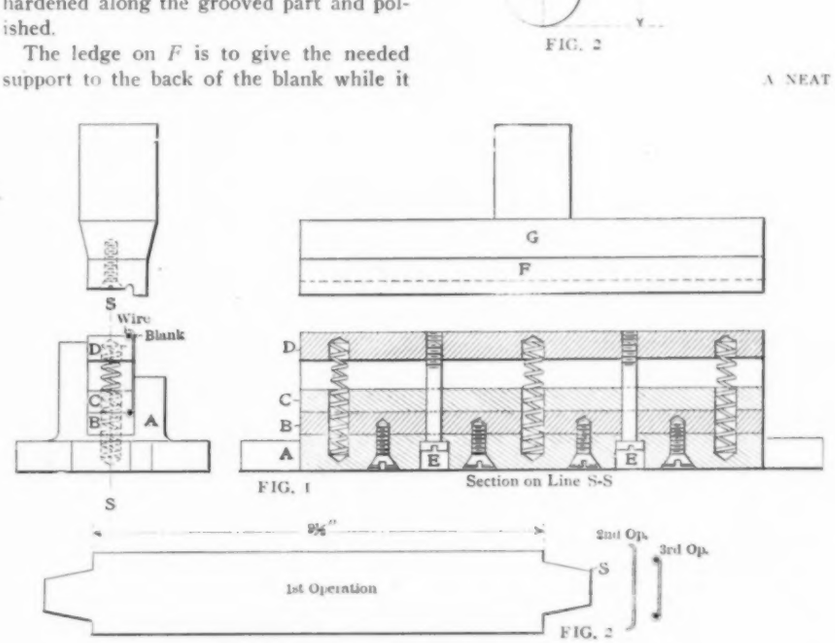


FIG. 1 FIG. 2

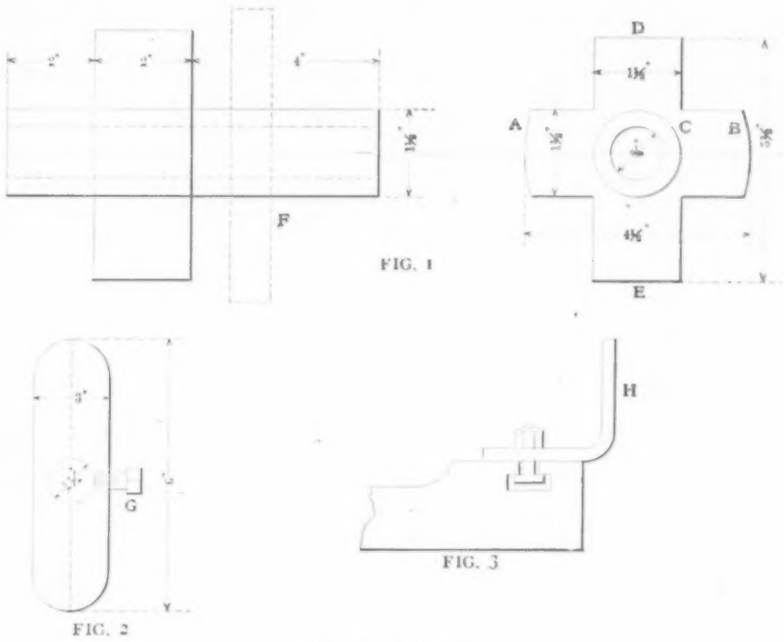
A SET OF CURLING DIES

A Neat Lathe Job

We had a number of castings like Fig. 1, to be finished all over. The principal difficulty was with the arcs *A* and *B*, which were to be turned concentric with the diameter *C*, as the distance from *D* to *E* was greater than from *A* to *B*.

We took a Flather lathe and removed the cross-feed screw so the cross slide worked freely. We then attached a piece of belting to the cross slide and with a weight on the other end rigged it over a small idler at the back end of the carriage. Next we put on the thread stop, as usual for cutting threads. A piece of ½x2 compressed steel was bent and bolted on the cross slide just to the right of the tool post, as shown in Fig. 3. Next we made a piece like Fig. 2, 3x6x1, which we slid on the work in the position shown at *F*. It was held on by set-screw *G*.

As the work revolved, the thread stop regulated the depth of cut at *A* and *B*, and the cam (Fig. 2), striking the bent piece *H*, moved the tool back while the projection *D* and *E* passed.



A NEAT LATHE JOB

REUBEN.

American Machinery Condemned

According to a report furnished to the British Government by Captain Kennedy, director of the public works department in Sudan, "a certain amount of special plant has been received from America, and this, though excellent in design, has been in every single instance of an inferior quality structurally. For example, some well-boring plant—of the American oil-well type—though admirably designed, was of the very worst description, with faulty castings and bearings and unfinished machine work. Some steam-road rollers also, designed for special work, were found to be manufactured and finished in a manner that certainly fell far short of the ordinary British standard. In consequence of this, it has in some cases been found advisable, in the case of special plant of American types, to obtain the detailed designs from America and have the manufacture of the same carried out in England."

Molding Part of a Type-casting Machine

Methods of Molding in Dry Sand and in Green Sand, and of Treatment after Pouring, in Order to Insure a Satisfactory Casting

BY R. H. PALMER

As one listens to the explanations given a visitor to an iron foundry of how the molders make molds of damp sand to withstand the intense heat of the molten metal, and cast successfully some of the complicated castings seen in foundry and machine shops, one is apt to think that it requires brains as well as muscle to be a molder; but could these visitors hear some of the compliments (?) paid a molder when a poor casting is discovered, they might also think that a large percentage of his make-up was stupidity, carelessness and pure cussedness. Molders do not differ very much from most human beings, however. When as the result of a mistake there is a lot of scrap instead of a sound casting, it is not always the man who made the mold who is to blame. As castings become larger, the number of men required to help in the pouring becomes greater, and many a molder has seen a casting come out of the sand poor owing to the inattention to business of someone else, and perhaps to a poor core.

Whether certain castings will go to the scrap heap or to the machine is often determined by their treatment after they have been poured. Some castings are necessarily not evenly proportioned, for one reason or another one part being required quite heavy and another part light. Castings of this description often cause the molder much trouble before he finds out just how the casting should be treated to keep it from warping and twisting while it is cooling off in the sand. To the average person a casting is only a casting; yet to produce some castings requires the best of care and attention from the molder, not only in making the mold, but in keeping it from cracking or warping when cooling off.

With a view to having the casting cool evenly, the competent molder looks carefully over the pattern and decides where he will uncover the casting to allow it to cool off faster in some particular spot, and how he will keep it covered, to keep the light part hot, by adding more sand over that part when the cope is "knocked out." And so he goes on, perhaps digging a core out here or there. The writer can remember many a hot job of this description which he had as an apprentice, and as a journeyman; he took his share along with the rest.

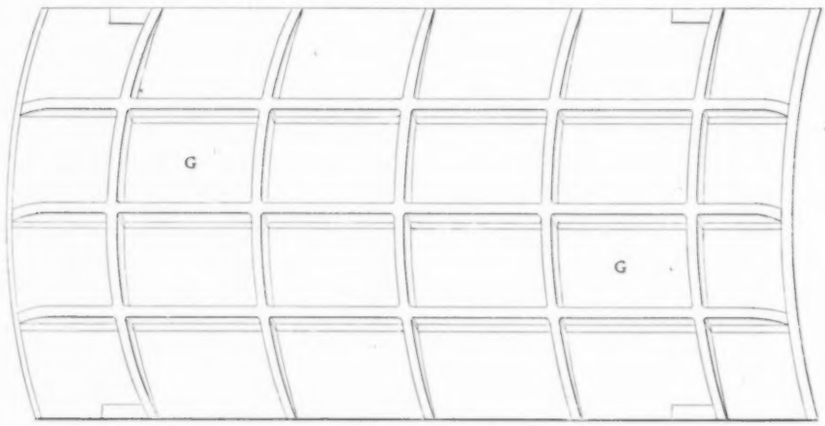


FIG. 1. TOP VIEW OF PATTERN

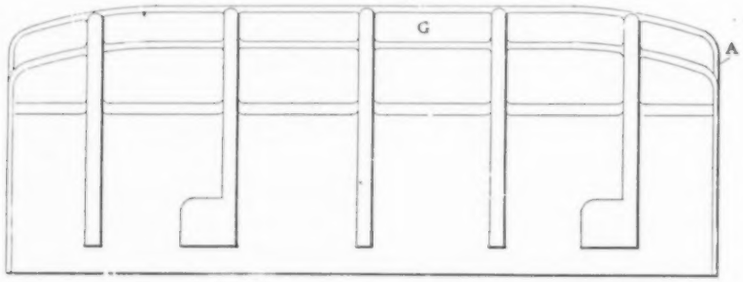


FIG. 2. SIDE VIEW OF PATTERN

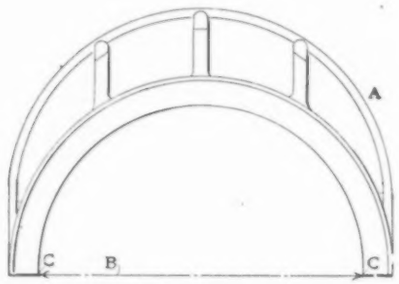


FIG. 3. END VIEW OF PATTERN

An Example

The foregoing remarks will be illustrated by describing the molding and after-treatment of a casting which is a part of what is called a "casting mold" for casting type metal, though, it may be remarked, the molding is not a difficult job. Fig. 1 is a top view of the pattern made at such an angle as to bring out the shape of the ribs, and Figs. 2 and 3 are side and end views, respectively. Fig. 4 is a side elevation, and Fig. 5 an end elevation of the flask, with the pattern shown in dotted lines. Fig. 6 is a plan of the top, showing the runner for pouring.

The part of the pattern shown at *A*, Fig. 3, is loose upon the lower part, and is held in place by pins. There is a brace through the center of the pattern at *B* to strengthen it, and keep it from spreading apart while being used for molding; when the molder finishes the pattern he stops this off in the mold.

Molding

The molder places the cope on the floor, partly rams it up with sand and proceeds to bed the pattern in, letting it come above the joint to the proper hight, and making a sort of rough parting. He then puts on the drag, rams that up, and drives wedges *D*, Fig. 4, through the flask pins *E*, thus fastening the cope and drag together; he then proceeds to roll them over. This done, he removes the wedges *D* and hoists off the cope and knocks it out. This is, of course, what is called a false cope, or one rammed up to take the place of a follow board, which is often done when a pattern is irregular, and will not lie on a board.

The joint is then made as shown at *F*, Fig. 4, and the part *A*, Fig. 3, is placed on the pattern. Some sand is placed in the pockets *G*, Figs. 1 and 2, formed between the ribs, in which to set gaggers, which are to help hold up and secure these pockets.

The cope is put on, the gaggers set, gate sticks *H*, Fig. 5, set, and the cope is rammed up. It is then well vented down into the pockets, hoisted off and rolled over.

Before the ribs are drawn out, the corners of the pockets are spiked, and the face is well vented with a finer wire than was used when the cope was vented before rolling over; the face is then made up, the pattern drawn and the cope finished.

Facing for Molding in Dry Sand

The facing mixture contains flour, fire and molding sand, wet up to the right degree of dampness with molasses water, and sometimes clay wash is added. Some persons prefer to black dry-sand molds green, as they are called before they are dried; others usually black them after drying. The molds blacked green will in most cases give the smoother castings. In most foundries the blacking for a dry-sand mold is composed of a mixture of "silver lead" and German powdered charcoal, the whole being wet up with a mixture of molasses water, and a little clay wash added. When used, the mixture is about the consistency of cream. It is put on the mold with a swab, allowed to set a little and is then slicked with a tool. Every foundryman, however, has some mixture of blacking for molds for his particular kind of castings.

The wedges *D*, Fig. 4, are driven into the pins *E* a second time, in order to hold the flask together. The runner box *J*, Fig. 4, is placed in position, and the runner *K*, Fig. 6, is built of molding sand with sprues *H*, as shown, through which the iron enters the mold.

In blacking a mold after it is dried the blacking is put on with a brush, care being taken that the mold is not too hot; when cool enough a pail of blacking and a pail of beer or molasses water, side by side, are used, the molder dipping his brush first in one and then in the other; it being found that in using the combination the blacking spreads more easily over the face of the mold.

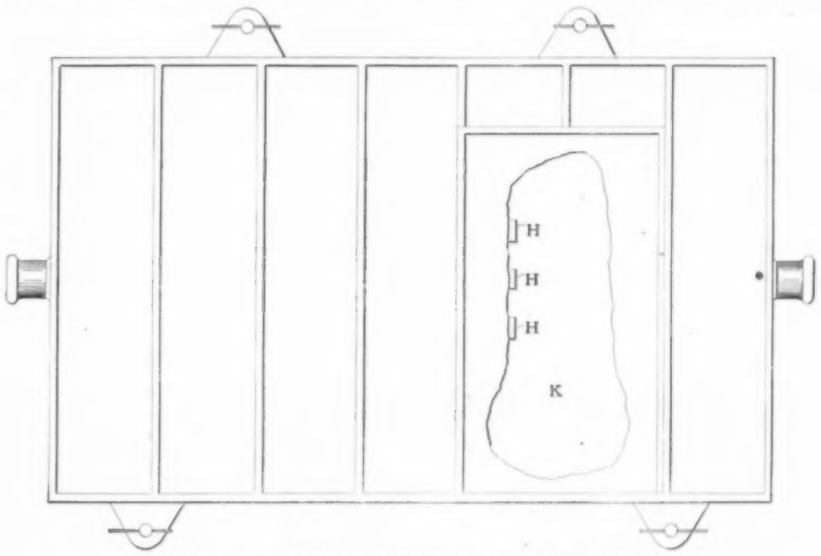


FIG. 6. PLAN OF MOLD, SHOWING RUNNER FOR POURING

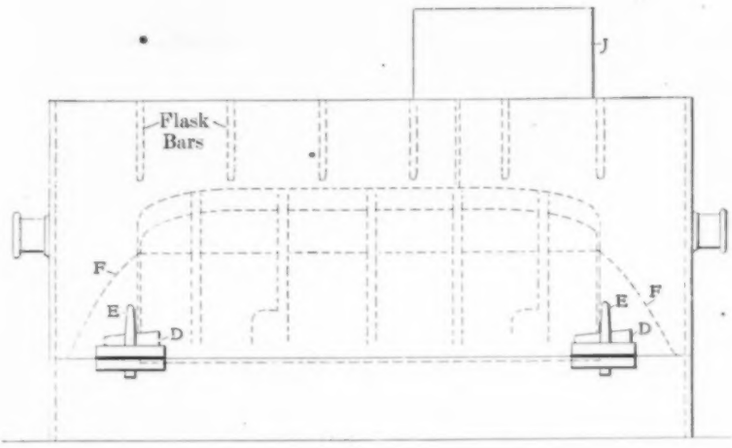


FIG. 4. SIDE VIEW OF FLASK, PATTERN DOTTED IN

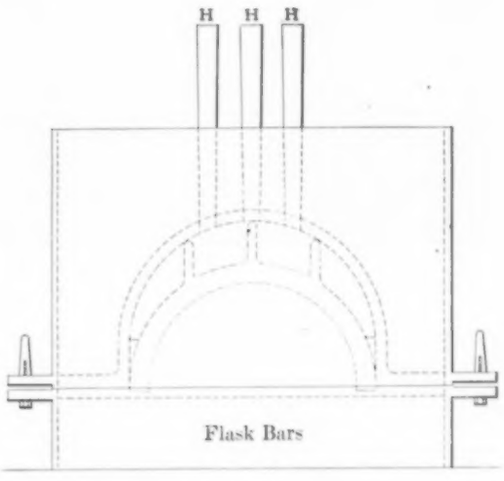


FIG. 5. END VIEW OF FLASK, PATTERN DOTTED IN

When the gate sticks are removed the cope is ready for the oven.

The drag, after having the pattern drawn from it, is finished, the brace at *B*, Fig. 3, is stopped off, the drag blackened, and cope and drag are placed in the oven to dry. When they are dry the cope is tried on the drag to see that there is no danger of crushing. A worm of clay or flour is rolled out and placed on the joint, or the joint is pasted, and the cope is closed on for good, the gate sticks having been put in place before the cope is put on.

Conditions After Pouring

It will be seen that the cylindrical portion of the casting is thicker than the ribs; and at the intersection of the ribs the thickness is a little greater still, as the patternmaker will put in fillets there to avoid sharp corners, and the molder will in all probability pinch the sand together a little more, so that at the points where the ribs intersect, the metal will be heavier. If the iron be too rich in phosphorus it will remain in a fluid state too long in these spots, and when the casting is machined and finished it will show spots where the iron looks open and spongy; in most cases these spots are found near the gates, but the metal near the intersection of the ribs being in a fluid state longer, the neighboring parts draw away from this, making at times spongy or open spots in the casting. Since for this job a close iron capable of taking a high finish is required, the spongy spots will cause the loss of the casting. From this it is evident that the chemical analysis of the mixture that goes into the casting is important.

If the casting be taken out of the sand too soon after pouring, exposing it to the action of the air, since the ribs are lighter than the cylindrical portion, the latter will give as the ribs cool and draw on it, thus causing it to open out, so that when the casting is brought to the machine to be

finished, it is found that the amount of finish allowance left by the patternmaker has decreased by the casting opening up between the points *C C*, Fig. 3. Furthermore, the ribs will sometimes check near the points of intersection.

To avoid such occurrences, if the wedges *D*, Fig. 4, be knocked out, and the cope hoisted up and left hanging on the crane with the casting in it, exposing the inside or concave part to the air, the heavy parts will be cooled off in the proper proportion to the ribs which are in the sand in the cope and the casting will give no trouble from cracking or lack of finish allowance. The ribs in the cope are kept warm since they are away from the air which is cooling off the thicker cylindrical portion. This treatment of the casting permits using a closer iron which will take on a better finish.

Comparison of the Green-sand and Dry-sand Molding

In molding the casting in green sand the operation of making the mold and securing the pockets is about the same, but the sand is molding sand wet to the required dampness, and next to the pattern a mixture of sand and "sea coal" is used. Greater care must be used in securing the pockets, ramming and venting them; otherwise the ribs on the casting will be found swelled out of shape, or scabbed. It will be found a good thing to prevent the mold from cutting the rounded surface where the iron strikes if some small nails are shoved into the mold, letting their heads come even with its face. When the mold is finished and blackened with a mixture of "silver-lead," it will be found that a little oil dropped on the corners of the pockets will help to keep them from cutting.

I believe that this example will bring out the point I wish to make, that in few shops is the molder's work all done when he has finished pouring his casting.

An Unusual Engine Wreck

By Milton W. Arrowood

It was caused by one of those mysterious slugs of water, and, as usual, the source of the trouble could not be definitely located. The engines are of the tandem compound type, having reheating receivers and exhausting to a pipe that passes horizontally underneath the floor to the condenser, which is located between the two engines. Figs. 1 and 2 show views of the wrecked engine after it was dismantled for repairs. The two engines are used to furnish power for a large grain elevator, and they had only recently been installed when the accident occurred.

It was about shutting-down time, and the engineer after going through the usual routine of shutting down, having closed the throttle and shut off the steam, as he supposed, was troubled by the fact that the engine continued to run longer than he thought it should; so he assumed something must be wrong with the exhaust side of the system. He thought that destroying the vacuum would make the engine stop quicker, so he stopped the vacuum pump; but unfortunately this proved to be the wrong thing to do, for no sooner had the pump been stopped than the head end of the low-pressure cylinder filled with water drawn from the condenser. The piston, returning toward this end of the cylinder and being suddenly checked by coming in contact with the water while the fly-wheel kept on turning, wrecked the low-pressure side of the engine. It was the momentum of the heavy 16-foot fly-wheel tending to move the parts against the incompressible wall of water that did the business.

How the Repair Was Made

The large crosshead guide barrel shown in the front of Fig. 1 was broken loose from the cylinder and so damaged that it had to be recast, while at the same time the pillow block of the main shaft bearing was broken on the side away from the engine. Of course the engine-repair man had to be called in, and it is of the manner in which the repair was made by W. H. Spring, expert of the Charles F. Elmes Engineering Works, of Chicago, that I write. When the new casting for the guide barrel had been gotten into position and fixed on its foundations and to the low-pressure cylinder, the engine being dismantled as shown in Figs. 1 and 2, several points of interest came up.

Among other things it was found that core sand had so scored the walls of the low-pressure cylinder as to make reboring necessary. To do this, of course, the piston rods and the pistons of both cylinders had to be removed. A problem was found in removing the low-pressure cylinder, which was jammed on its rod, owing to its impact with the water in the cylinder.

Fig. 3 shows the method used to get this piston off its rod, and by reference to the illustration it will be seen that considerable force was necessary to remove it. After the piston had been pulled out of the low-pressure cylinder, two heavy 15-inch I-beams were laid across the end of it, between it and the high-pressure cylinder. By means of two 3½-inch side rods these beams were supported in place and were connected to a heavy beam placed on the other side of the high-pressure cylinder. This beam served as a base against which to use the hydraulic press.

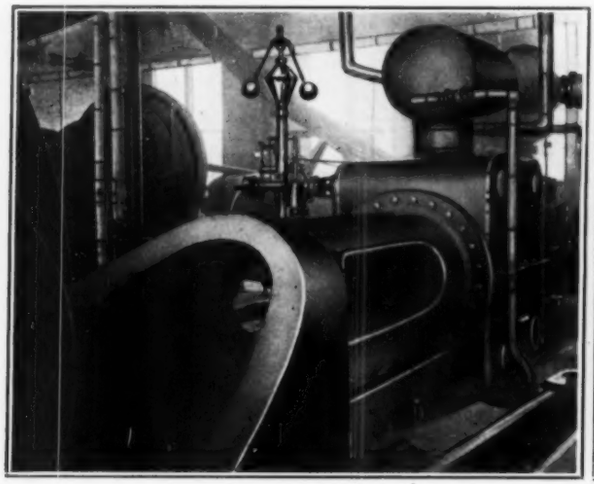


FIG. 1. GUIDE BARREL OF WRECKED ENGINE

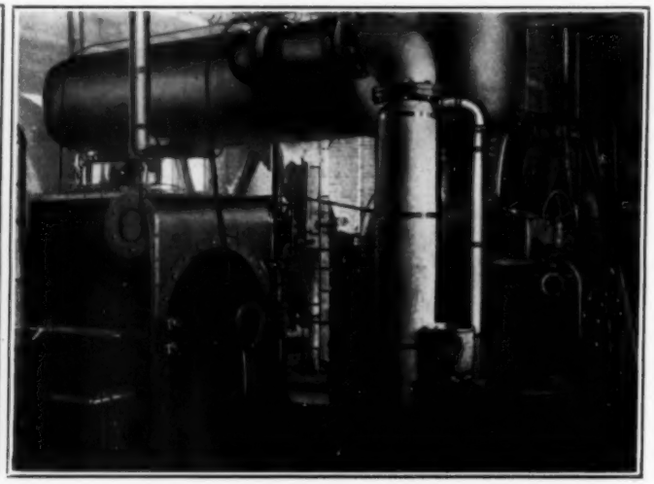


FIG. 2. REBORING LOW-PRESSURE CYLINDER

Forcing out the Piston

As seen in the illustration, a 300-ton hydraulic press was used against the end of the piston rod to force it out of the low-pressure piston while the latter was held immovable by the two I-beams placed between it and the cylinder, one on each side of the rod. The illustration

makes the manner of doing the job clear, and explanation is hardly necessary further than to say that 210 tons pressure and a 1-ton battering ram handled by five husky men was the force necessary to effect removal of the piston, showing that this was no small part of the job.

There was nothing particularly interesting in the manner of reboring the cylinder, as it was done in the conventional way, with a portable engine to drive the boring bar. The chief lesson to be derived from this part of the work is the necessity for thorough inspection in engine shops to make sure that no core sand is left in any part of the cylinder ports or valve-chest connections. Fig. 2 shows the end of the boring bar in position, with its support across the open end of the cylinder. After the inner walls of the low-pressure cylinder had been brought to a smooth working surface, examination showed circumferential ridges of considerable depth, say from 1/32 to 1/16 inch in the high-pressure cylinder, these having been caused apparently by the boring bar slipping on the job in the shop. Owing to the fact, however, that it was necessary to get the engine in service with as little expense as possible, this cylinder was not rebored.

After the work was completed and while final alinements were being made, it was found that the high-pressure cylinder had been set up and operated out of alinement, it being set to one side about ¼ inch as compared to the center line through the low-pressure cylinder. The wonder is how it was operated in this condition. Another thing found wrong was that the throttle valve had not been put in properly, so that the steam piping connections had to be torn out and the valve fitted in right.

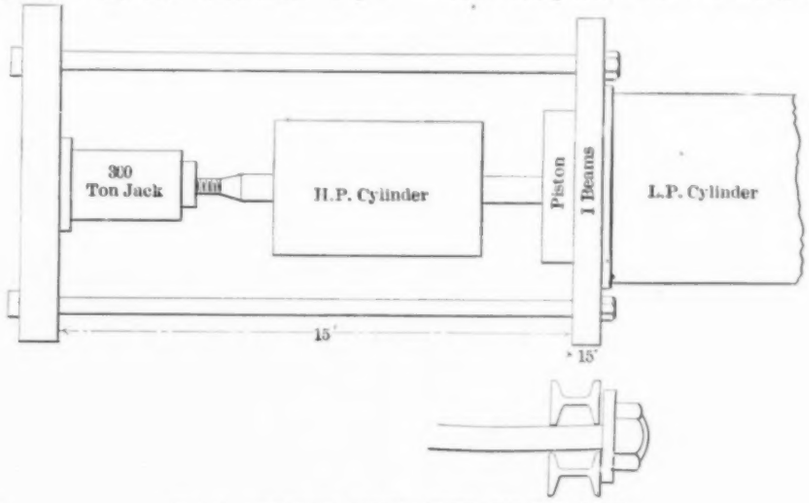


FIG. 3. REMOVING PISTON WITH 300-TON JACK

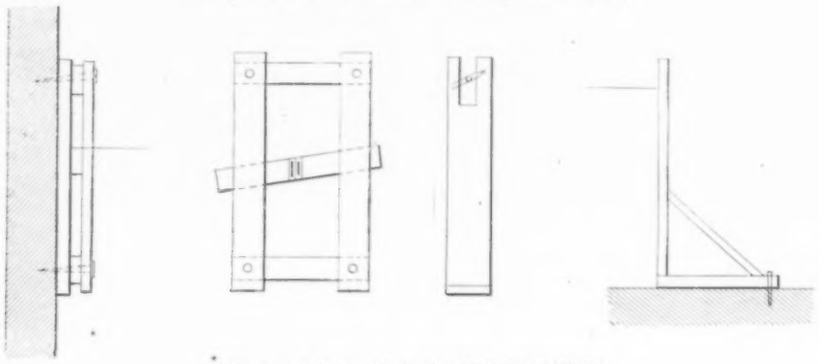


FIG. 4. FRAMES TO HOLD CORD FOR LINING

Lining up the Cylinders

Fig. 4 shows the device used for lining up the cylinders, which, although it may not be new to all readers, is deserving of mention as it has considerable merit. It is simple and can be made on the spot in about ten minutes, consisting essentially of soft-wood pieces, about 1x2 inches in size and of length as required, made up into a frame as shown. The frame is nailed to the wall, a stanchion or a post and, owing to the fact that the cross bar is a tight fit, it will remain accurately in any position set, by means of a few taps of the hammer. One end of the alining cord is attached to the cross bar and the other is tied to a nail stick or other cross piece, which is put back of a stanchion of the form shown in Fig. 5. The ordinary form of gage rod is used to get the distance of the line from the walls of the cylinder, it being simply a stick with metal points on each end formed by driving a nail into each of the ends for the distance necessary to make the rod of exactly the right length.

The use of the apparatus is familiar to all having to do with the lining up of an engine, and the particular merit of the device is the stability of the cross bar shown in Fig. 4, which, when once put in place, may be depended upon to remain there, thus making unnecessary a large amount of checking work required where the ordinary method is used, the cord passing through an auger hole and being tied to a nail that is placed in position and is always likely to slip. If care is taken to have the pieces of which the frame is made of the same thickness, the cross bar will be of the desired tight fit and everything will be lovely for the man doing the alining. He will know that once put so, the thing is so, and there is no chance after the final check, of having a slip that would put the whole job out.

Case-hardening

By E. A. Dixie

In a shop I visited recently they were doing some pretty nice case-hardening, and they were doing it with a material that I had always been prejudiced against, i.e., prussiate of potash. The methods used for keeping track of the results were excellent. Naturally all work of approximately similar size was hardened in the same box, as it would obviously be wrong to mix work of large and small cross section, owing to the greater length of time the large pieces would require to absorb the carbon.

Into each lot test pieces of approximately the same cross section as the pieces to be hardened were put. These test pieces have a complete record stamped on them, date, job number and so on. They are of course made of the same material as the pieces being hardened.

After the pieces have been hardened the test pieces are broken to show the depth of case-hardening and the texture. If they are satisfactory the pieces are put into stock to be used as required, and the test pieces are filed away, so that, should any of the pieces fail in use, the date and condition under which they were hardened can easily be looked up. Should none of the pieces fail inside of two years, the test pieces are scrapped.

The articles are graded according to size and packed in iron boxes containing the following mixture: Prussiate of potash, 5½ lb.; salt, 10 lb.; sal soda, 15 lb.; hickory charcoal broken to the size of pea coal, 1 bushel; water, 2½ gallons.

On large work of an approximate cross section of 3x1¼ inches the boxes remain in the furnace 13 hours. In that time the test pieces, on being broken, show a depth of from 1/16 to 1/10 inch. Smaller pieces require less time.

Each article is file-tested by the workman who incorporates it in a machine.

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Notice

Hereafter the subscription price of the weekly AMERICAN MACHINIST to Canada will be $5.50, postage paid. This raise in price is made necessary by the new postal treaty increasing the postage rate to Canada a little matter of 400 per cent.

Industrial Insecurity

The subject of industrial insecurity is one which at some time or other is pretty apt to be brought forcibly home to the machinist and to skilled workmen in other lines, as well as to the man who follows an occupation where special training and ability in any given direction is not essential. That particular phase of the subject which may be called insecurity of employment has from time immemorial exerted a dominating influence over the habits and customs of individuals and communities, and doubtless will continue to be a factor of wide importance until the arrival of the industrial millennium. It has, for example, in many instances prevented workmen from acquiring homes of their own, especially in small towns where one or two industries constitute the only opportunities of employment for those residing in the locality. It has, too, frequently taught the workman the lesson of thrift and the necessity of making provision against want in possible periods of idleness in the future. Not infrequently apparent insecurity of position has been the cause of men leaving the employment of others to embark in business for themselves, and in this way has in a degree been beneficial to the country at large by bringing about the establishment of new industries destined to give employment to numerous workmen, some of whom will in the course of events, and possibly from much the same motives as actuated their employers, find it desirable to branch out in some line of manufacture themselves.

In this connection it is pertinent to note that, although business generally may be flourishing throughout the country, with machine shops as a rule and manufacturing establishments not only running full time but in many cases over time as well, and with tool builders, for example, having more or less real difficulty in getting as many of the desirable class of mechanics as they have openings for, there is a certain line of work, requiring skilled men for its successful accomplishment, in which positions appear at times as insecure as if the industries of the nation as a whole were practically at a standstill. We refer to the work carried on in the navy yards, where, upon the completion of each undertaking of any magnitude, scores and even hundreds of men are liable to be thrown out of employment and a greatly reduced force of operatives maintained until the next important piece of work for the Government is taken in hand. If one examines carefully the annual reports of the Chief of the Bureau of Construction and Repair he will find some interesting data pertaining to the fluctuation during the year in the number of men employed at the various yards.

This feature of somewhat irregular employment in the places referred to naturally results in more or less disorganization of the working force and corresponding difficulty in bringing it up to the requisite standard when extensive operations are again necessary, although so far as possible the men laid off for lack of work are given the preference as experienced hands when business at the yards increases. One of the arguments advanced by those who believe in the Government building its own vessels is that such work provides a means of keeping up a suitable force of experienced mechanics that can in case of necessity be utilized in part for doing the repairs and refitting of the various ships in the navy. Although it is the object of the authorities to have this work done gradually throughout the year, it so happens that with the growth of the navy there is apt to be periodically a heavy rush of operations to be performed at the important yards, with a corresponding falling off of work when the ships are at sea. While a considerable diminution of the force engaged in building a man-of-war would be detrimental in that it would seriously delay the completion of the vessel being built, with the result that its period of service as an important unit of the navy would be even shorter than under present conditions, where a battleship becomes obsolete quite rapidly enough, still there are various classes of ships of less importance which without doubt might be built by the navy yards and the force engaged on which might satisfactorily be drawn upon for doing the repairs referred to without serious disadvantage to the new work in progress. But, in any event, an accession of shipbuilding in the Government yards could not help but aid in the general betterment of these establishments, provide a more flexible organization and result generally in more satisfactory conditions from the point of view of both the authorities and the workmen.

It is of interest to note here that, so far at least as the New York yard is concerned, there is less likelihood of men being thrown out of work there in the immediate future than was often the case in former times. The collier "Vestal" now under construction there will provide employment for an extensive force, probably for two or three years; and from this force will be drawn to a certain extent the labor required in keeping up repairs on the ships now in commission. An order of importance to this yard as well as to others along the Atlantic coast has recently been issued by the Department

of the Navy. This order assigns each vessel in the Atlantic fleet to a certain yard which shall be considered its home yard, where all dockings and repairs are to be made. The larger vessels are to make an annual visit of thirty days or less to their yards for general overhauling, and a second visit, each year, of not over ten days for docking and survey. Cruisers, gunboats and other vessels will be overhauled at such times as work can be done on them without interfering with operations on battleships. The vessels assigned to the New York yard include five of the largest battleships, a cruiser and a number of gunboats and smaller vessels.

The Supply of Iron Ore

Alarming ideas have been circulated of late regarding the remaining supply of known iron ores existing in the earth, the opinion having been freely expressed that not many decades will elapse before the available stock of such ores is substantially exhausted. The current issue of *Cassier's Magazine* contains an article on the iron-ore supplies of Great Britain, by T. Good, which is intended to dispel this fear, and in a considerable measure must do so.

Near the beginning of his article the author states that these pessimistic opinions are, in his opinion, "as unfortunate as they are unfounded." His examination is, of course, limited to the sources from which Great Britain draws her supplies of ore, but it is largely regarding these sources that the alarming reports have been circulated. He begins by pointing out that, so far from the large increase of consumption of British ores, which has been assumed, there has been in recent years an actual decrease due to an increase in the importation of foreign ores, chief of which are those which come from Spain.

A writer in the London *Times* has stated that the best orefields of Spain would be exhausted within the next 10 years, the fact, according to Mr. Good, being that there are about 60 years' supply in the now workable fields of Spain, at the present rate of consumption, with vast deposits yet untapped and large portions of the country unexplored for minerals. In Great Britain we are told that there are something like 1,000,000,000 tons of iron ore "in sight," while the present consumption is but 14,000,000 tons annually; and since these alarming predictions were first made five important discoveries of iron ore have been made within the British islands, one of which is officially reported as "of great magnitude and excellent quality." In addition to this it is known that there are positively enormous reserves of inferior ores, which while unavailable at present, will doubtless become of use with the progress of metallurgy in the future; and, indeed, under reduced mining royalties the mining of these inferior ores has already begun. In addition to the home and the Spanish supplies are those of Norway and Sweden, which are enormous in extent, and of which those countries appear to have comparatively little need.

In forecasting the future of the iron industry the author lays stress upon the fundamentally superior economic advantages of Great Britain as compared with the United States—pointing out that while our ore deposits and coalfields are a thousand miles apart, and that the furnaces, because of the location of the coal mines are situated from 400 to 500 miles from the seaboard, in Great Britain the ore, the coal, the furnaces and the ships are practically side by side. He considers it indisputable that "Great Britain can profitably produce pig iron, the foundation of her steel and engineering trades, just as she can build ships, at a cost below that of other countries."

The author regards the fear of an iron famine as a bogy, which he places alongside of a similar bogy of a few years ago, namely, the then supposed impending exhaustion of the coal supply of Great Britain—a fear which has been dispelled by an official inquiry. He concludes by saying: "There are no facts within our knowledge to warrant belief in the probability of an iron famine within our time," and that Great Britain "need not cease to be a great iron-producing nation within the next 250 years."

The Epidemic of Broken Rails

That the broken-rail problem has reached the acute stage is shown by the fact that a joint committee of experts, representing the American Railway Association and the rail manufacturers, has been appointed for the investigation of the problem. The railroads blame the rail mills, claiming that the rails turned out have not been up to specifications, and in particular that the limit of phosphorus specified has been exceeded, although why these rails were accepted and used and the facts kept hidden until the present epidemic forced them out is not specified. On the other hand, the makers blame the roads for putting down rails which are too light for the present-day heavy traffic. Meanwhile, there is a distinct movement toward the extensive adoption of rails made from open-hearth steel, in place of those made by the Bessemer process, the Harriman lines especially having placed orders with the Tennessee Coal, Iron and Railroad Company for the delivery of 15,000 tons of rails per month during the last 10 months of 1908. Heretofore the bulk of the rail orders for these lines has gone to the western mills of the United States Steel Corporation. The difficulty of meeting the specifications as regards phosphorus is limited, it appears, to the mills working the Bessemer process, and is due, no doubt, to the exhaustion of the low-phosphorus ores which are essential when the Bessemer process is used. The entire situation points to the early abandonment of the Bessemer process, so far as rail making is concerned, and that, of course, has been its great field in the past.

Convention of the National Association of Manufacturers

The twelfth annual convention of the National Association of Manufacturers will be held in this city at the Waldorf-Astoria Hotel, May 20, 21, and 22. Among the speakers at the business sessions will be: Hon. Charles A. Prouty, of the Interstate Commerce Commission, who has promised an address on "Further Railroad Legislation;" Hon. Francis B. Loomis, formerly Assistant Secretary of State, "Some Practical Results of the Convention Reform Agitation;" Charles M. Pepper, special agent of the Department of Commerce and Labor to investigate trade conditions in foreign countries, on "Foreign Trade: How to Get it and Keep it;" Dr. Charles P. Neill, Commissioner of Labor, Department of Commerce and Labor, on "Certain Aspects of the Child Labor Problem;" Arthur D. Dean, on "Trade Schools; the Manufacturer's or the Pedagogue's Sort;" Capt. Henry A. Castle, late auditor of the treasury for the Post Office Department, on "Needed Postal Reform."

An unusually large number of members have already signified their intention of being present, and the convention is expected to be most important in the history of the association.

New Publications

AMERICAN PATTERN PRACTICE. By H. J. McCaslin. 227 6x9-in. pages. The Frontier Company, Cleveland, O. Price, $3.

This book is divided into six sections or general headings, so that any particular subject can be found in compact form and to allow for future additions without disturbing more than the section involved. It includes engine patterns, molding and cores, sweep work, gearing, miscellaneous representative patterns such as throttle valve, hawser pipe, truck bolster, skeleton patterns, etc. The final section has forty-four pages of hints, suggestions and rigs, which include many practical kinks that ought to help any patternmaker who has not had an exceptionally wide experience. There are so few really good books on pattern work that this should find a welcome place in the library of the men who want all the practical information obtainable. It is well printed, the illustrations are good, and it is a good beginning for the new publishers.

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

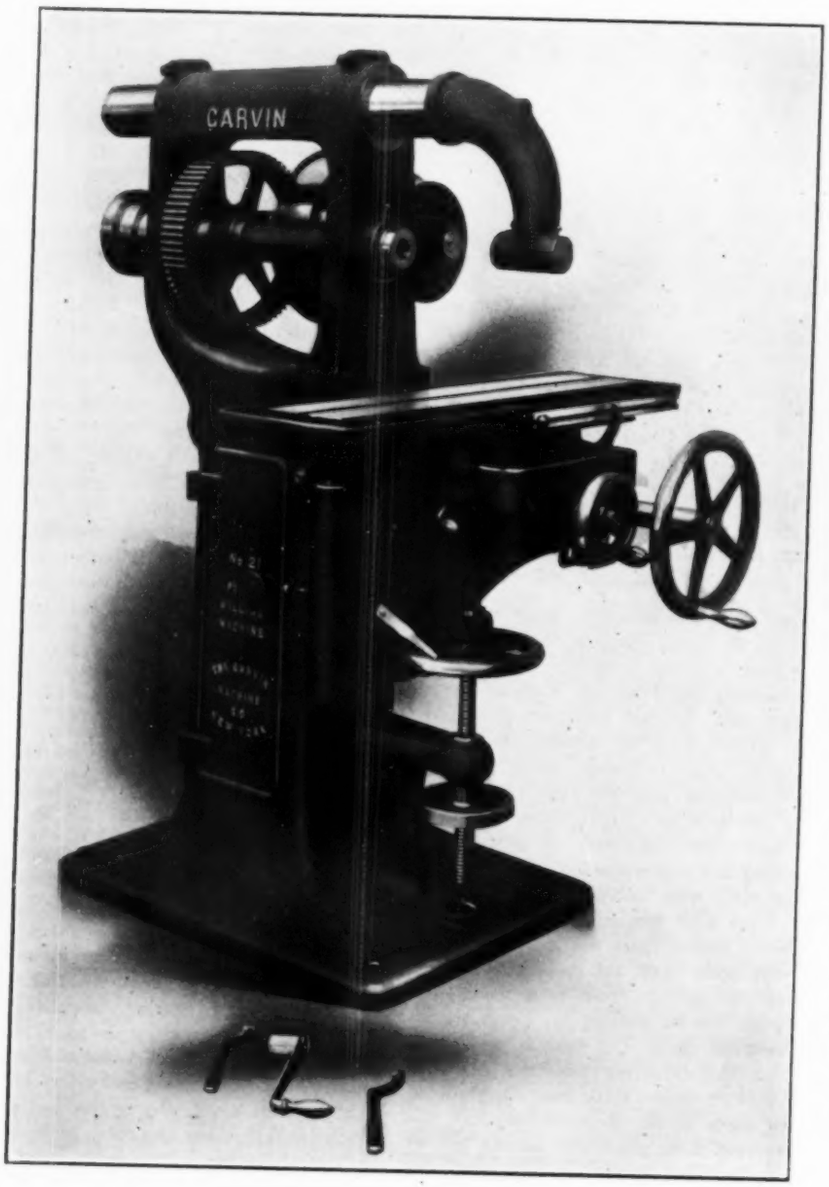
THE LATEST INFORMATION

A Plain Back-geared Milling Machine

The half-tone illustrates a plain milling machine. It has the hand wheel for the longitudinal motion of the table in front of the knee, near the hand wheel for the cross feed.

The elevating screw passes through a bracket near the base. Above this bracket is the hand wheel for raising and lowering the knee. The upper surface of this wheel is graduated and has a pointer, as shown. Below the bracket is a hand nut for locking the screw in any desired position.

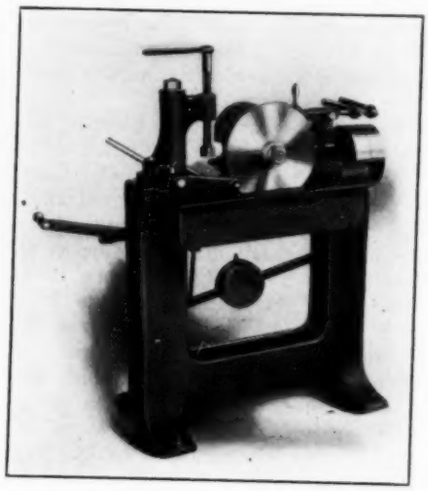
It is back-geared and has power feed. The table measures 6x30 inches inside of the oil pockets. The spindle has a No. 10 Brown & Sharpe taper hole. The builder is the Garvin Machine Company, New York City.



A PLAIN BACK-GEARED MILLING MACHINE

Improved Cold Saw

The illustration shows a machine for cutting off stock to 3½ inches round, or flats, squares and other shapes not over 3x3½ inches, pipe, etc. It uses a saw blade 10 inches diameter by 3/32 inch thick and, it is stated, will cut off blanks to within 0.005 inch of parallel, the saw blades usually lasting for months of steady cutting. They are ground, when necessary, on a bench grinder furnished with the machine. The feed is by gravity, a weight and lever being used, which feed keeps the saw up to its work at all times, even though the blade may be considerably out of round. The blade is driven through steel pinions and worm and worm gear, the worm being provided with ball thrust bearing. An automatic trip stops the machine after a cut has been completed, preventing buckled saw blades. A stock stop is also provided so that any number of pieces may be cut off exactly the same length. This tool is manufactured by John T. Burr & Son, 431 Kent avenue, Brooklyn, N. Y.

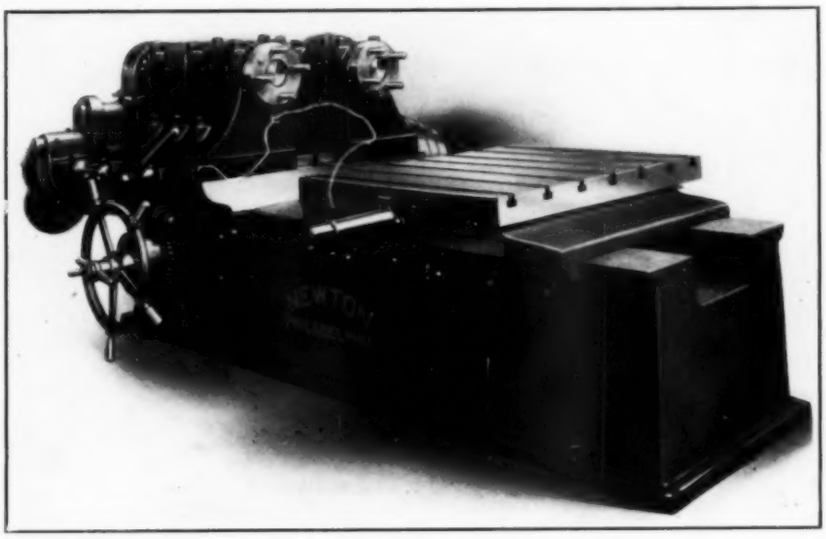


IMPROVED COLD SAW

Special Double-spindle Boring Machine

The special double-spindle boring machine here illustrated was designed particularly for boring gas- and gasolene-engine cylinders. The spindles are driven through intermediate gearing, hardened-steel worms which continually run in oil, and steep-lead phosphor-bronze worm

wheels, by a cone giving four changes of speed. The spindle heads are both adjustable from a minimum distance of 10¾ inches to a maximum distance of 24 inches between center of spindles. The work table is 48 inches wide by 36 inches long and has a longitudinal hand adjustment and power feed with four changes. The cross-adjusting screws of the table and spindle heads are fitted with micrometer measuring gages. One of these machines recently installed at the Buffalo Gasolene Motor Company, driving their special boring bar, has been found to give better finished surfaces than could possibly be obtained by reaming. This company has found that the operation on a two-cylinder engine, with cylinder bore of 8 inches diameter, 18 inches long, was completed in one hour and forty minutes; a 7x16-inch double cylinder in one hour and thirty minutes, with a spindle speed



SPECIAL DOUBLE-SPINDLE BORING MACHINE

of 12 revolutions per minute and a feed of 3/32 inch per revolution. In both these cases two boring cuts were taken and a very fine bore produced.

The machine was designed and built by the Newton Machine Tool Works, Philadelphia, Penn.

What is said to be the only railway in America operated by the three-phase alternating-current system is one between London and St. Thomas, Ontario, operated by the Southwestern Traction Company. The current is generated and transmitted at a potential of 10,000 volts and at sub-stations it is stepped down to 1000 volts and fed to the two trolley wires. The third conductor is formed by the rails. The motors used are those of Ganz & Co., of Austria. In order to run through the city of St. Thomas the cars are to be equipped with direct-current motor equipment as well as the three-phase motors.

The Best Way to Study the Best Books

By Entropy

On page 503 H. L. Turner gives a list of books for home study, and asks for opinions from those who have a better knowledge of the subject than he has. I wish to take the liberty of saying something on this subject, but I want it thoroughly understood that I do not believe that I am even as well posted on the subjects covered by these books as Mr. Turner must be if he has conscientiously followed his course of reading. But what I wish to say is not so much on the particular books to be used, for I believe that to be a minor point, as on the method of using the books that may be at hand.

Two Ways of Using Books

There are two good ways of attacking a subject by the aid of books. One is to employ some capable man to prescribe a course, just as you would get a physician to prescribe for a disease. He would select a list of books and say to his client, read this chapter in one book, and then that in another; then take section so and so in the third and so on. And then this expert would follow up the work of the student and change the course from time to time as needs might develop.

This is just what is done in colleges. Many men in the shops have an idea that it is a great deal easier to learn at college than at home. It is a little, but not much. A college professor is simply a man who is sufficiently well acquainted with the subjects he is teaching so that when one explanation fails to impress a student he can give him another, which he can grasp; beyond that he is only a rudder.

The Spur of Discipline

The college discipline is a prod to keep up the lazy. The college association, the companionship of others who are studying, too, is the chief thing which makes it easier for the boy in school to learn than for the man in the shop. If it were not for this, the best way for a man who wished to add to his early education would be simply to get hold of a set of books used at any college in the courses which he would like to follow, and read those books. But it is a rare individual who has the persistence to wade through a mass of elementary drudgery with no other encouragement than the hope that ultimately it may lead up to the study of something else that may prove interesting and useful. The schools find it absolutely necessary to prod students from behind with the fear of losing their standing, and encourage them by the association of others who are studying the same way; and they find this even more true of the older students, men who have been out in the world earning their living, who have come back to study further. They need to be kept up to their work just as much and even more than boys who have never been out of the habit of book study.

A Practical Way

The other way in which a man may study is absolutely non-scientific, but it is more likely to be carried out.

He may become interested in some particular thing, as, for example, to know whether the beams in a traveling crane are strong enough for an overload. He finds that the makers of beams publish hand-books with tables which give the loads which their beams may carry without exceeding a certain fiber stress. He finds out that his beams may carry a certain load at certain specified fiber stresses, but he wants to know whether this fiber stress varies with the load, and why it is that a beam will carry only half the load in the middle that it will carry if the load is spread out along its length.

He works a few of the formulas that he finds in the hand-books, and gets an inkling that there is something more to be found out from the men who made the formulas. The first thing he knows he is down at the library evenings with Merriman's or Lanza's or Church's "Mechanics" at his elbow, probably all of them, and a number more. They would have staggered him if he had begun on them at first, and even now he has to hunt first in one and then in the other to find explanations that he can comprehend. And oftener than not he has to assume that these fellows know what they are talking about and build on that.

Moment of Inertia

For example, the moment of inertia of various sections. Nowhere can he find a simple explanation of what it is nor how to get it for any of even the simpler forms of cross-section; but if he assumes the authors are right he can go on and use

their results to build up the moment of inertia for complicated sections. If he did but know it, this is about all that the college chap knows, too. But he may not be satisfied with this; he must dig down through calculus and other forms of mathematics to get to the root of the thing. But he knows what he is after, and every step has been of value, so he is content to dig and dig persistently till he gets the whole thing out by the roots.

This may look discouraging, but it is really just about what the college-educated chap has to do five or ten years after he graduates, if he has not been doing this work all the time.

Don't for a moment think that they remember all these things that they learned in school. They do not; they simply recognize them when they study things out later on, and they know better where to look for various things in the books, but they have to get down and dig just the same.

THE DRAWBACKS OF THIS PLAN

It must be admitted that there is a disadvantage in this way of getting an education, in that it tends to an education along just the lines in which one happens to be working. It is not apt to help one to go to another job of a different kind. But it is better than no education, and if with this you can persuade yourself to spend the time now given to a perusal of murder trials and divorce scandals in the daily press to reading some of the older and tried and tested fiction, just for a rest, you will find that you will surely broaden out under the treatment; and in any case if you depend on a public library and turn first from one author to another in your quest for technical education, you will find that it is setting you to thinking for yourself, and that is the chief object and end of any education.

Obituary

Lieut.-Col. George V. Fosbery, inventor of the Paradox gun, an automatic revolver, etc., died at London, May 8.

Business Items

Wickes Brothers, Saginaw, Mich., have moved their New York show room and offices to West Street building, Cedar and West streets.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York, are bringing their catalog file up to date and would like catalogs from manufacturers.

The New York office of Hill, Clarke & Company, Incorporated, has been moved to the West Street building, 136 Cedar street, occupying the northeast corner on the ground floor.

Wells Brothers Company, Greenfield, Mass., manufacturer of taps, dies, screw plates, etc., has opened a store at 54 West Washington street, Chicago; Bordwell & Barton Company, in charge.

The Remington Oil Engine Company, Stamford, Conn., manufacturer of kerosene oil engines, both stationary and marine types, has built a new factory on Pacific avenue, to take care of its greatly increased business.

The new plant of the Michigan Copper and Brass Rolling Mills of Detroit, will have two 5-ton, 3 motor electric traveling Northern cranes. These cranes will be installed by Northern Engineering Works, Detroit, Mich.

Eberhardt Brothers Machine Company, gear specialist, of Newark, N. J., is building a one-story addition to its factory. The extension will accommodate several new planers, and a new engine room, to increase the production of automatic gear cutting machines.

The New York office of the B. F. Sturtevant Company has just been removed from 131 Liberty street to the new engineering building at 114 Liberty street, where much better facilities will be provided for conducting the rapidly increasing business of this company.

The machinery and equipment department of the Cincinnati Iron Store Company, has added to its sales organization, Harry E. Wessling, who was for a number of years connected with the Dreses Machine Tool Company, and later with the William Powell Company.

Trade Catalogs

Scully Steel and Iron Company, Chicago, Ill. May and June stock list. Illustrated.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 146, illustrating and describing electric propeller fans.

T. R. Almond Manufacturing Company, 83-85 Washington street, Brooklyn, N. Y. Circular illustrating and describing the Almond coupling.

Cincinnati Machine Tool Company, Cincinnati, Ohio. Catalog of upright drilling and tapping machines. Illustrated, 48 pages, 6x9 inches, paper.

Robins Conveying Belt Company, 13-21 Park Row Building, New York. Special bulletin No. 44, describing package conveyor system. Illustrated.

Ingersoll-Rand Company, 11 Broadway, New York. Booklet No. 20A, describing Temple-Ingersoll electric air drill. Illustrated, 19 pages 3½x6 inches.

William Gardam & Son, 45-51 Rose street, New York. Bulletins No. 2 and No. 14, illustrating and describing single and multiple spindle sensitive drill presses.

Gisholt Machine Company, Madison, Wis. Catalog describing American turret lathe, universal tool grinder, vertical boring mills. Illustrated, 14 pages, 8x10 inches, paper.

The Bourse, Philadelphia, Penn. Sixteenth annual report of the directors submitted at meeting held May 14. Booklet giving prospectus of The Bourse, and containing cards of admission.

Edgar T. Ward & Sons, 23-25 Purchase street, Boston, Mass. Catalog and price list of cold drawn seamless steel tubing. 28 pages, 3½x6 inches, paper. Price list of Capital high speed polished drill rods.

The Indestructible Fibre Company, Wendell & MacDuffie, 26 Cortlandt street, New York, sole selling agents. Pamphlet describing "Fibrite," "Durite" and "Kantilite," for car headlinings and marine work.

Manufacturers

The Bristol (Conn.) Brass Company, will erect an addition.

The Greenlee Bros. Company, Rockford, Ill., has plans for a large foundry.

The DeMoines (Iowa) Bridge and Iron Works will erect shops in Pittsburg.

The Standard Optical Company, Spokane, Wash., will enlarge its plant and add new machinery.

The Harbison-Walker Refractories Company, Pittsburg, Penn., will erect a plant at Indiana Harbor.

The Denton (Texas) Woven Wire Company has been organized; capital, $75,000. J. M. Rayzor, president.

The plant of the Ensley (Ala.) Machine and Foundry Company, recently burned, will be rebuilt at once.

The Dean Electric Company, Elyria, O., manufacturing telephone and electrical supplies, will build a new five-story factory building.

The Virginia Electric Tool and Manufacturing Company, Petersburg, Va., is establishing a plant for the manufacture of electric hammers.

The E. Ingraham Manufacturing Company, Bristol, Conn., clock manufacturers, will expend about $40,000 in new construction and equipment.

The F. R. Dengel Manufacturing Company, Milwaukee, Wis., plumbers' supplies, will erect an addition and spend $40,000 in improvements.

The Trumbull Manufacturing Company, Warren, Ohio, is making extensive improvements to its foundry. A new gas plant is to be installed.

The Mancelona (Mich.) Screen Company, has been organized to manufacture screen doors and windows. Capital, $10,000. John Otis, president.

The shops of the El Paso & Southwestern Railroad at Carizozo, New Mexico, which were burned some time ago, will be rebuilt on a larger scale

The Des Moines (Iowa) Scale and Manufacturing Company, will move to a new location and install new machinery to build large mine scales.

The Seneca Chain Company, with plants at Kent and Zanesville, Ohio, is erecting a plant in Mansfield, where it will establish its principal industry.

The Colorado Southern, New Orleans & Pacific Railroad will erect a car repair shop at Beaumont, Texas. B. B. Gordon, Beaumont, chief engineer.

The Goodspeed Manufacturing Company, Colorado Springs, Colo., is planning the addition of a general foundry for the manufacture of steel and iron castings.

It is reported that the Lenoir Car Works, Lenoir City, Tenn., will double the capacity of its plant and manufacture all kinds of wooden railroad equipment.

The plant of the Indianapolis Switch and Frog Works at Springfield, Ohio, was destroyed by fire entailing a loss of about $75,000. It will be rebuilt.

The Trenton (N. C.) Buggy and Manufacturing Company has been incorporated for the manufacture of buggies, carts, etc. Thomas D. Warren is interested.

The Colorado Southern, New Orleans & Pacific Railroad has begun the erection of new repairs shops at De Quincy, La. B. B. Gordon, Beaumont, Texas, chief engineer.

The Oklahoma Malleable Iron Works Company has been incorporated at Shawnee, I. T. Capital $200,000. J. R. Pring, Charles McCormick and H. D. McKee, incorporators.

The Improved Scale and Foundry Company, Harrisonville, Mo., will erect new buildings, including foundry, machine shop, engine room, etc. J. W. Colburn, Jr., president.

The Acorn Metallic Packing Company, St. Louis, Mo., has been incorporated to manu-

facture piston-rod mechanical devices by C. Charlton Perry, Earle C. Perry and others.

The Myers Clay Manufacturing Company has been incorporated at Birmingham, Ala., with a capital stock of $10,000 to manufacture clay pipe, etc. J. E. Budwig, president.

The Standard Wire Fence Manufacturing Company has been organized at Fort Worth, Texas, with $25,000 capital stock. Site has been purchased for a plant. Oswald Wilson is president.

The Leaksville (N. C.) Furniture and Lumber Manufacturing Company, recently incorporated, will erect a plant for the manufacture of sashes, doors, blinds, etc Address J. M. Hopper.

The E. H. Lawson Company, manufacturers of tinplate and tinware, Cincinnati, Ohio, is taking bids for the construction of factory buildings to replace those recently destroyed by fire.

A. C. Koenig and George J. C. Collins, civil engineers, Omaha, Neb., are organizing a company to manufacture ball bearings especially for automobiles. The company will be capitalized at $150,000.

The Elmwood Casting Company, recently organized with a capital of $100,000 has purchased a site in St. Bernard. James Stacey, of the Stacey Manufacturing Company, Cincinnati, Ohio, is president of the new concern.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper catalog free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Contract machine work, tools and dies to order. Northwestern Machine Co., Detroit, Michigan.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Good foreign patents to sell in Europe. W. H. Booth (of London and Paris). Care AMERICAN MACHINIST, New York.

Slide rule, verbal instructions. F. F. Nickel, 150 Nassau street, New York. Compressed air table 29" vacuum to 4000 lb., 25c.

Wanted—Bound volumes of the AMERICAN MACHINIST for 1905; must be in first-class condition; state price. Address L. P. Sittig, Buckingham Place, Chicago, Ill.

Wanted—Foreman mechanic to help me buy stock of a Pittsburg machine shop doing jobbing and light manufacturing business. Address B. F. Bain, Pittsburg, Pa.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—A responsible concern to place on the market a material for case hardening which revolutionizes present methods. Address "Inventor," AMERICAN MACHINIST.

Arrange with us to do your manufacturing; we build special machinery, special tools, etc. Lewis Blind Stitch Machine Company, 502 North Commercial St., St. Louis, Mo.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Foundry corporation having large contract for automobile cylinders, pistons, etc., desires to connect with progressive machine shop equipped to do necessary machining; no assembling. New England. Care AMER. MACH.

A partner wanted to take half interest in an automobile shop. Must take either end of business, the work shop or sales department; business running for five years; shop and store takes in hundred dollars per day. Box 976, AMERICAN MACHINIST.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers, 146 West 56th street.

Advice; mechanical, practical and technical; tell me your needs. I'll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y., U. S. A.

To engineer furnishers—We are in a good position to take up an agency for a special line in engineers' furnishings. For over 20 years we have been agents for the largest bolt and nut manufacturers in France and have a splendid connection with ironmongers, etc., throughout Scotland and Ireland. Apply John Hurry & Sons, 27 Commerce St., Glasgow, Scotland.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Designer on hoisting machinery—college graduate, 6 years' drawing room and shop experience—wants to change; best of references. Box 970, AMERICAN MACHINIST.

Superintendent wishes to make a change, accustomed to fine and medium heavy interchangeable work; a designer of modern tools, jigs, and special machinery for rapid production. Box 899, AMERICAN MACHINIST.

ILLINOIS

Foundry and machine works superintendent, broadly qualified; 35 years practical and technical experience; proved executive and business ability; seeks responsible position in small or medium sized city; ample references; salary an object. Address "Widower," AMERICAN MACHINIST.

MASSACHUSETTS

Superintendent or shop manager; experienced in manufacture of light machinery; designer of special tools; factory organizer and buyer; age 36. Address Box 975, AM. M.

Manager or master mechanic open for engagement; wide experience and business acumen; money making results from men and materials; constructive policy; do not require ideal conditions; age thirty-two, married. Box 946, AMERICAN MACHINIST.

NEW JERSEY

Draftsman; technical graduate; 29 years of age; highest references, is open for engagement. "H C.," Box 967, AMER. MACH.

General foreman; high-grade duplicate work; tool designer; water meter work a specialty. Box 947, AMERICAN MACHINIST.

NEW YORK

Draftsman wants position; complicated machinery or jigs. Box 959, AMER. MACH.

Superintendent of well-known concern desires change; good mechanic and executive; has made others and can make your plant pay. Box 917, AMERICAN MACHINIST.

Practical mechanic; technical and business training, with initiative and capacity; 17 years' executive experience, wants position as factory superintendent. Box 924, AM. M.

Mechanical draftsman—third-year student of mechanical engineering at Cooper Union, 5 years' drafting-room experience and 2 years' shop work—wishes position. Box 974, AM. M.

Tool designing draftsman; technical graduate on die, jig and fixture work; 15 years' experience, 6 years' shop, desires position; East or West. Box 963, AMER. MACHINIST.

Superintendent; age 37; wide experience on interchangeable work, special machinery and metal specialties; executive ability and excellent manager of men. Address Box 802, AMERICAN MACHINIST.

Wanted—Position as superintendent, manager or purchasing agent by mechanical engineer of 10 years' theoretical and practical experience; good business man, energetic and reliable; holding position at present. Box 961, AMERICAN MACHINIST

Foundry foreman — efficient, energetic, strictly up-to-date in molding machine, green and dry sand work, married man, age 38, strictly non-union—desires to make change; salary $2600 first year; highest references. Box 972, AMERICAN MACHINIST.

Machine-shop foreman—33, with 12 years' experience on small, interchangeable parts, designing tools, jigs, etc., and establishing system for manufacturing and cost purposes—is desirous of making a change; best of references. Address Box 973, AMER. MACHINIST.

Technical graduate, 6 years' drafting experience, 4 years designing and checking; experienced on testing and operating gas engines; single, and can go anywhere; now employed; good references. Desires position with chance to rise. Address Box 971, AMER. MACHINIST.

Technical college graduate, Sweden 1899; 6 months' experience as machinist and molder; 2 years 8 months draftsman at tool-machinery company, Sweden, 3 years 6 months engineer at stove and farming machinery company, Sweden, 1 year 10 months draftsman in America; wants position as draftsman. Address Box 965, AMER. MACHINIST.

WEST OF MISSISSIPPI

To correspond with parties wanting up to date instructor in machine shop, forge and foundry practice. Box 923, AMER. MACH.

Help Wanted

Classication indicates present address of advertiser, nothing else.

CALIFORNIA

Wanted—Draftsman; first-class man with experience in general engineering and construction work; applicants must state age, qualifications, references and salary. Solar Observatory Office, Pasadena, Cal.

CONNECTICUT

Wanted—First-class all-round machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Wanted—Machine designer familiar with rolling mill machinery; rapid and accurate; permanent position; state age, experience, reference and salary required. Box 964, AMERICAN MACHINIST.

GEORGIA

Wanted—Machinists to work in one of the best shops in Atlanta; good places for good men; open shop. E. Van Winkle Gin & Machine Works, Atlanta, Ga.

MICHIGAN

Wanted—By an established Michigan gasolene engine manufacturer an experienced draftsman and designer to take full charge of drafting department; applicant must be up to date in factory details and a hustler; to such a permanent position is offered; state age, married or single, reference and salary expected; communications treated confidentially. Box 915, AMER. MACHINIST.

Mechanical superintendent for machine shop doing contract work on small parts and employing two hundred men; must be a thoroughly capable mechanic and have had several years 'experience in handling the men; must be able to design jigs and tools for rapid production of duplicate work and able to give references as to ability and character; all communications confidential. Box 949, AMERICAN MACHINIST.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

Draftsman Wanted—Large lead mining company, 65 miles south of St. Louis, Missouri, wants draftsman for mechanical drafting and for making surface and underground maps; must be first-class freehand letterer and neat workman; man with knowledge of plotting and calculating survey field notes preferred; applicants please submit specimens of work and state salary wanted. Box 867, AMERICAN MACHINIST.

NEW JERSEY

Wanted—First-class mechanical draftsman on tools, jigs and shop fixtures, located 35 minutes from New York City. Box 962, AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate complicated work; steady work and good wages to thoroughly

competent men; give references. Address Box 438, AMERICAN MACHINIST.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

NEW YORK

Several good planer hands on wood working machinery castings. Box 969, AMER. MACH.

Wanted—A number of first-class textile machinists. Apply to 542 West 52nd St., New York.

Opportunity for bright, energetic boy to learn machinists trade. Rotary File and Machine Co., 589 Kent Ave., Brooklyn, N. Y.

Wanted—Experienced draftsman, toolmakers and machinists; give age, references and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Man to develop a new type of printing press; must be an expert mechanic, familiar with this class of work; capable of installing them on completion; an exceptional opportunity to the right party. Address with references and salary wanted. Box 966, AMERICAN MACHINIST.

Wanted—Machinists capable of doing strictly high-grade work, particularly bench and floor men; answer by letter, giving references and experience and stating wages wanted; we are not having labor troubles, permanent positions to competent men. Utica Industrial Company, Rome, N. Y.

Foreman for foundry in Mexico. Must be a practical man, a competent mechanical engineer, draftsman, able to calculate and make up estimates; principal work is building of mining and agricultural machinery; must be able to take complete charge of foundry and be competent to act as general manager of establishment during absence of manager. Address, giving terms and previous experience, "X," Post-office Box 367, N. Y. City.

NORTH CAROLINA

Wanted—First-class all-around machinist for job shop; must be sober and quick. Carolina Machine Co., Fayetteville, N. C.

OHIO

Wanted—Good mechanic for erecting electric cranes. Apply, giving experience, Case Mfg. Company, Columbus, Ohio.

Wanted—One machinist experienced on a 3-A heavy Brown & Sharpe Universal Milling Machine. State wages expected and experience. Leidecker Tool Co., Marietta, O.

Head draftsman for a Cincinnati machine tool shop of 100 hands; one with experience on radials and turret machinery preferred; state experience and salary. Address Box 913, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class machinists, floor and machine hands. Bury Compressor Co., Erie, Pa.

Wanted—Machinists, fitters and machine hands; desirable class of machine tool work. Colburn Machine Tool Co., Franklin, Pa.

On account of increase of plant, we want molders, lathe, planer and floor hands; good pay and steady work to good men. Address or apply Ridgway Machine Company, Ridgway, Pa.

Wanted—Machine shop foreman for plant employing about 40 hands manufacturing engine lathes and special machinery; must be a first-class man and come well recommended; state salary wanted. Address Box 968, AMERICAN MACHINIST.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA

Wanted—A machinist familiar with repair work on blanking presses and dies. Address "W," AMERICAN MACHINIST.

Wanted—First-class toolmakers for small jig and die work; also machinists accustomed to small work. Apply by letter or personally, American Telegraphone Co., 57 18th Street, Wheeling, W. Va.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

For Sale

Test Indicators. H. A. Lowe, Cleveland, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

One universal drafting machine 18"x24" in perfect condition, $18. D. J. Kelsey, 315 Y. M. C. A., New Haven, Conn.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Bartlett, E. E., Boston, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction

American Tool & Machine Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio

Collectors, Pneumatic

Sturtevant Co., B. F., Hyde Park, Mass.

Columns, Water Alarm

Binghamton Machine Tool Wks., Binghamton, N. Y.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compound, Cutting

New York Lubricating Oil Co., New York.

Compound, Slushing

Warren Bros. Co., Boston, Mass.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Aurora, Ill.
Ingersoll-Rand Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Machine Co., Boston, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Link-Belt Co., Philadelphia, Pa.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Corundum

See Grinding Wheels

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery

Veeder Mfg. Co., Hartford, Ct.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders Iron Fdry. Prov., R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

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THE WHITNEY MANUFACTURING COMPANY,

HARTFORD, CONNECTICUT, U. S. A.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Brown Hoisting Mach. Co., Cleveland, Ohio.
Case Mfg. Co., Columbus, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Phila., Pa.

Crank Shafts

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, Ohio.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.

Cutters, Milling—*Continued.*

Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers

Veeder Mfg. Co., Hartford, Ct.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York City.
Safety Emery Wheel Co., Springfield, Ohio.
Superior Corundum Wheel Co., Waltham, Mass.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.
Risdon Tool Wks., Waterbury, Conn.

Dies, Sub-Press

Risdon Tool Works, Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, oCnn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Husschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Radial—*Continued.*

Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, Ohio.
Knecht Bros. Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Coates Clipper Mfg. Co., Worcester, Mass.
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Aurora, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

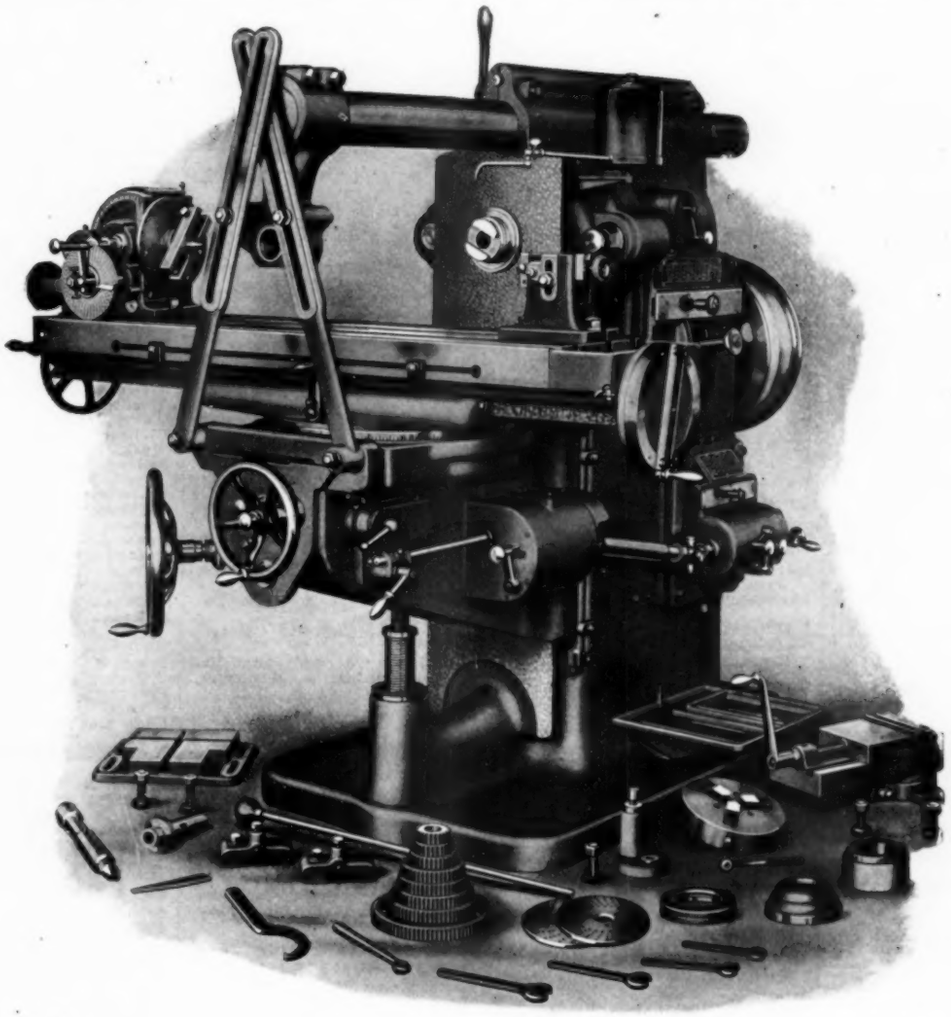
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

BROWN & SHARPE MFG. CO.

Providence, Rhode Island, U. S. A.



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Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Lincoln Motor Wks. Co., Cleveland, O.
Ransom Mfg. Co., Oshkosh, Wis.
Roth Bros. Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York City.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Engineers, Consulting and Architects

Thompson, Hugh L., Waterbury, Conn.

Engineers, Consulting and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers

Bormay Engraving Co., New York.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Machinery Exchange, Boston, Mass.
Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.

Fans, Electric

Backus Water Motor Co., Newark, N. J.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust

Backus Water Motor Co., Newark, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps

American Swiss File & Tool Co., New York.
Barnett Co., G & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron

Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines

Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Fire Brick

McLeod & Henry Co., Troy, N. Y.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Machy. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forging Machinery

The Scranton & Co., New Haven, Conn.

Forgings, Drop

Bethlehem Steel Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic

Bethlehem Steel Co., So. Bethlehem, Pa.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Machine

Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel

Baldwin Steel Co., New York.
Bethlehem Steel Co., So. Bethlehem, Pa.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers

Sturtevant Co., B. F., Hyde Park, Mass.

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American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling

American Gas Furnace Co., New York.

Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
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Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Turner Brass Works, Chicago, Ill.

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Tate, Jones & Co., Pittsburg, Pa.

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Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester, City, N. Y.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.
Williams Valve Co., D. T., Cincinnati, Ohio.

Gas Blowers and Exhausters

Sturtevant Co., B. F., Hyde Park, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
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Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant-Lees Mach. Co., Cleveland, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
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Walcott & Wood Mach. Tool Co., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

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Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut

Bair & Gazzam Mfg. Co., Pittsburg, Pa.
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Davis, Rodney, Philadelphia, Pa.
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Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co, Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
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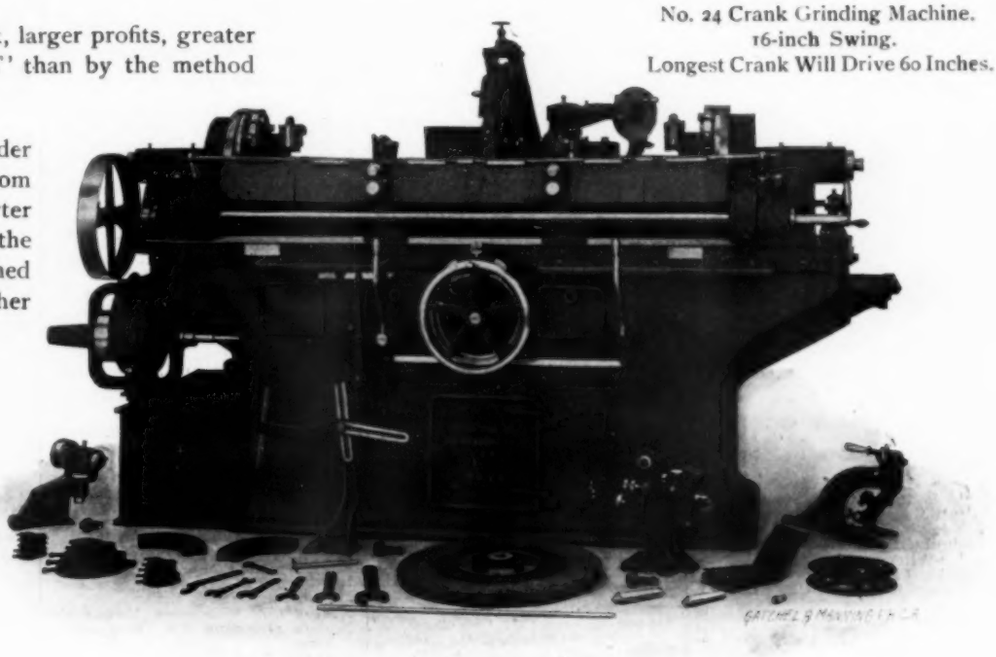

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Nuttall Co., R. D., Pittsburg, Pa.
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Albro-Clem Elevator Co., Philadelphia, Pa.
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Windsor Mach. Co., Windsor, Vt.

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Cincinnati Milling Machine Co., Cincinnati, O.
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Heald Machine Co., Worcester, Mass.
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Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.

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Tindel-Morris Co., Eddystone, Pa.

Grinders, Tool
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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
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Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
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Hammers, Pneumatic
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Prentiss Tool & Supply Co., New York.
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Niles-Bement-Pond Co., New York.
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Hoists, Hand
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Largest Concrete Machine Shop in the World

The Buildings and Method of Construction of the New Plant of the United Shoe Machinery Company, at Beverly, Massachusetts

BY L. P. ALFORD

It is seldom that a large machine-shop plant having a number of buildings devoted to various lines of work is constructed as a unit and from a definitely formed plan and purpose. Too often such plants are the product of years of growth, without any effort at uniformity in the arrangement of buildings or design, and the result is an effect of motley. The Elliott street plant of the United Shoe Machinery Company, at Beverly, Mass., is a pleasing example of the results which can be obtained by adhering to a definite plan in treatment of site, arrangement of building and architectural features, without sacrificing any points of utility.

The Site

The site for this large plant consisted of several adjacent farms, comprising together about 250 acres located in the city of Beverly. The surrounding territory was country, which provided ample opportunity for developing homes for the employees. This point was taken into consideration in selecting the site, in addition to the advantages which it possessed for a manufacturing plant. Furthermore the city is easily reached from Boston, being only 19 miles out, and has an excellent train service.

Historically it is interesting to note that the first shoe shop in America was built only a few miles away, in the town of Danvers, and the river that once carried among its cargoes barrels of shoes for the slave trade is now to furnish a highway for raw materials for the greatest shoe-machinery factory in the world.

A small river originally flowed through the center of the tract, and at one end toward the southward, the property abuts on tidewater; a branch of the Danvers river. Toward the westward and northward are a number of acres which would never be used for manufacturing purposes, but which can be, and have been to a certain extent, developed as homes for the employees; in fact, at one point a village

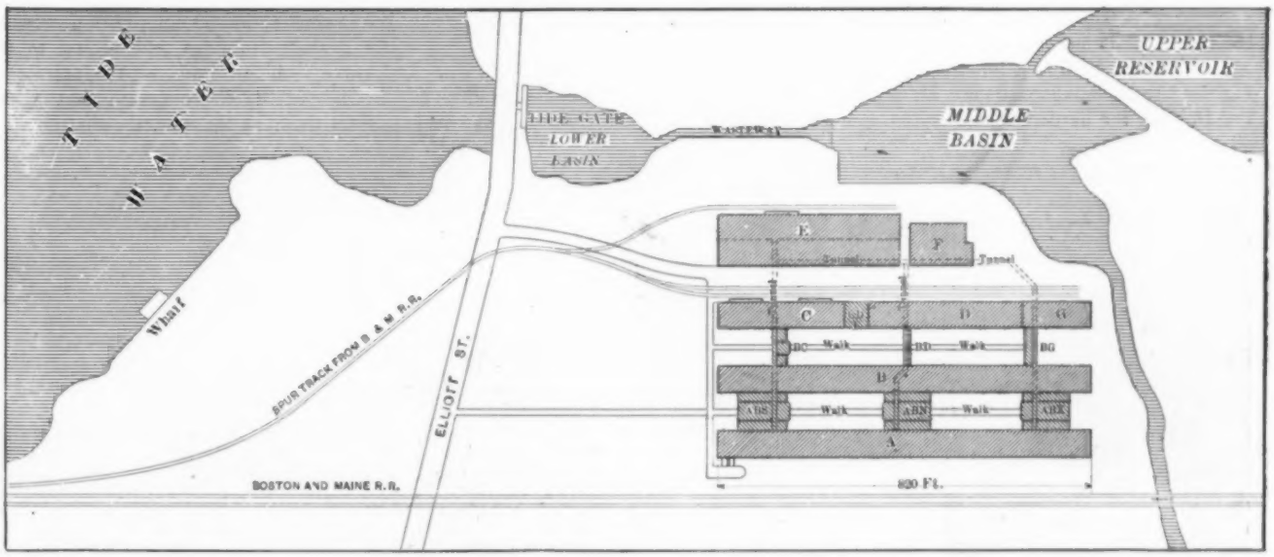


FIG. 1. PLAN OF BUILDINGS AND SURROUNDINGS

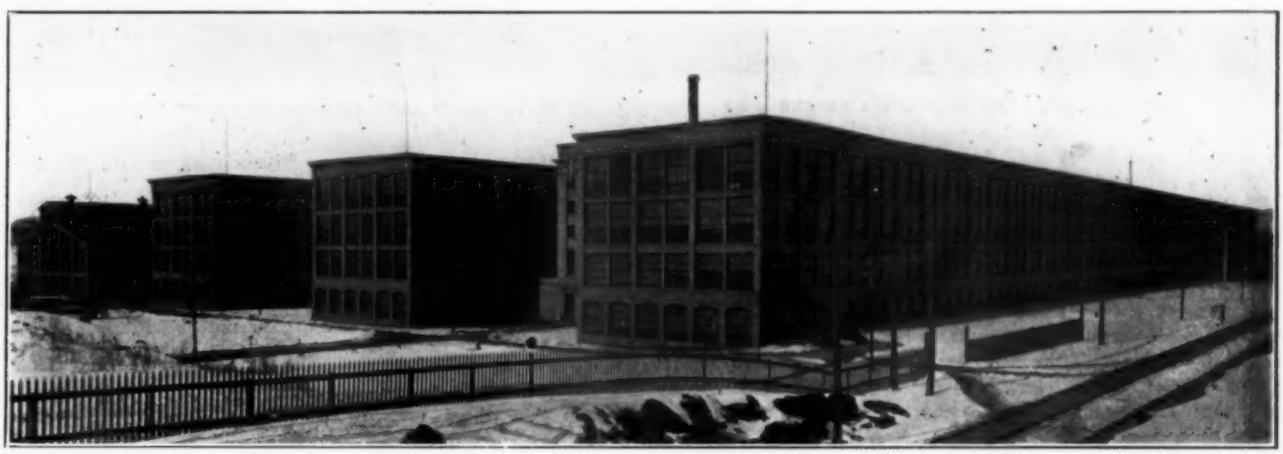


FIG. 2. THE BUILDINGS

of 75 to 100 houses has already sprung up, the houses in a large measure being owned by employees of the company. These houses have not been built or controlled in any way by the company itself, the land having been purchased by a real estate firm which built the houses and sold them on easy terms.

The Buildings

Fig. 1 shows a ground plan of the buildings, 14 in number, and their distinguishing letters. There are two main machine-shop buildings *A* and *B* running parallel with the railroad track and connected by three toilet-room wings, designated *A B S*, *A B N* and *A B X*. These machine shops form the first two rows of main buildings, and contain all of the regular machine-shop work or manufacturing. In the third row is building *C*, used for storage and shipping; *C D* a toilet-room wing for the use of buildings *C* and *D;* building *D*, used for hardening, tempering and forging; and building *G* devoted to receiving and storage. This latter has the factory restaurant on the top floor. These buildings of the third row are connected with building *B*, or the building which forms the second row, by three passages, designated *B C*, *B D* and *B G*. Of these passages *B C* and *B G* are four stories in hight, the hight of the main buildings of the plant, while *B D* is only one story in hight. The reason for this is that building *D* is a one-story building.

The fourth row of buildings contains the foundry, designated *E*, and the power station, designated *F*. This fourth row is not as long as the other three. Behind this fourth row are the storage basins for fresh water, which were formed by throwing dams across the river, with a spillway connecting them. Behind the foundry is the storage yard for the usual foundry supplies.

The main plant was built in 1903 and 1904, the actual manufacturing in it having been started shortly after the first of January, 1905. The main buildings which were built at that time had a length parallel with the railroad track of 520 feet. During the year 1906 an extension of 300 feet was added to the three rows of buildings nearer the railroad tracks, making these rows 820 feet long. An addition was also built to the power station.

In this article the plant will be treated as a whole, except as some changes may be mentioned, showing improvements embodied in the new construction over the old. In general the same type of construction was carried out in the extension as was used originally, and great care was taken to preserve the same architectural features, so that the entire plant as it now stands is a consistent whole.

Treatment of the Site

By referring again to the plan Fig. 1, it will be seen that the river was dammed at two places, making two storage basins of different levels, in order to have a large supply of fresh water for factory use. The storage capacity is about 40,000,000 gallons. Near the street a tide gate was built in order to control the action of the tide. Originally the tide set back quite a distance up the river. Across the street and directly opposite the end of the plant a bulkhead has been built to form a wharf. To reach this wharf a channel has been dug by the city of Beverly, giving a depth of 18 feet of water at high tide, which will permit the bringing in of material and supplies by barges and schooners after the wharf property is entirely developed. Toward this work the State of Massachusetts appropriated $25,000; the balance of the expense was borne by the city.

A siding from the railroad passes the wharf, and serves trackage behind the fourth row of buildings, namely, the foundry and power station, and also the third row of buildings; that is, the row of buildings devoted to the receiving, shipping and storing of material. Thus all the material enters and leaves the rear of the plant.

Owing to the natural slope and grade of the soil a ground grade of 14 was determined upon for the area around the buildings, and the lower floor of the buildings themselves was fixed at grade 14.5. This grade is only 2 feet above mean high tide, and introduced some problems in connection with waterproofing. This decision in regard to grade, however, permitted all of the buildings, with the exception of the eastern side of building *A*, for a portion of the first story, to be entirely above the ground level; thus aiding communication between the various buildings and adding to the feature which was kept prominent throughout the entire design, that is, excellent facilities for natural light.

FIG. 3. LIGHT COURT BETWEEN A B S AND A B N

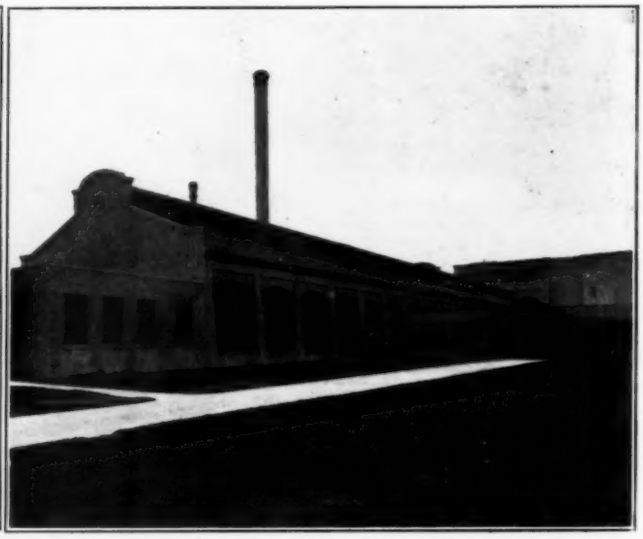


FIG. 4. FORGE SHOP FROM COURT BETWEEN B C AND B D

General Dimensions of the Buildings

A view of the completed plant is shown in Fig. 2. The main buildings are 820 feet long, as has been stated, and have a uniform width of 60 feet and a clear ceiling hight under the girders of 11 feet for all floors, with the exception of the second floor, which has a clear hight of 12 feet. This additional hight was given to the second floor because that level was to be used for the heaviest part of the manufacturing work.

The buildings are spaced uniformly 80 feet apart and have large light courts between them. Fig. 3 shows one of these courts. There are also light courts between the toilet-room wings and the main buildings, in order to care still further for the important feature of natural light. The employees enter the buildings through *A B S* and *A B X*, where courts give access to *A B N*. The wings contain about

28,000 square feet of floor area each. All of the buildings are uniformly four stories in hight, with the exception of the foundry, forge shop and power house. The only other exception to this rule is in the toilet-room wings, which have a hight slightly greater than the main buildings in order to accommodate six floors. Two floors are introduced in the nature of decks, to give sufficient area for the wash rooms and locker rooms. The wing buildings *B C* and *B G* connect all four levels of building *B* with buildings *C* and *G* respectively. In addition to providing passageways they contain small rooms which are used for tool vaults or tool storage. Building *C* is 280 feet long and is uniform in width and hight with the main buildings. *C D* is one story in hight.

Building *D* is of the same width as the other buildings, is 350 feet long, and has a monitor roof to allow for the escape of gases and heat. Fig. 4 shows the exterior of this building. Building *G* is of the same type and dimensions as *C*, except in its length, which is 150 feet.

The foundry is of an unusual type for its purpose, in that the molding floor is on the second-floor level. It is 390 feet long, 109 feet wide, two stories in hight, with a sub-basement. Fig. 5 shows the exterior.

The power station is a building 150 feet long, 90 feet wide and is divided into two rooms, generator and fire room respectively. This has a ceiling hight of about 35 feet. The main smokestack is 200 feet high and has a 9-foot flue; there is also an auxiliary stack 125 feet high, with a 6-foot flue. This building is considered the most pleasing architecturally and has been pleasantly referred to as the "daughter of the regiment." Fig. 6 shows the exterior.

The most noticeable feature of the exterior of the plant is the glass area of the walls. It is 90 per cent. of the entire wall area. Upward of 55,000 lights of glass have been used.

The lines of the buildings are simple and strong. There is no ornamentation. The overhanging cornice is the only feature of exterior embellishment. The impression given by the exterior is one of extent, simplicity and strength.

As indicated by the title, the buildings are constructed entirely of reinforced concrete, with the single exception of the roofs of buildings *D* and *E*. The chimneys are also of concrete steel. This construction applies to all parts of the shell—foundations, columns, walls, floors, ceilings, and roofs. The roof is, of course, covered with a composition roofing, as the concrete itself is not water-tight. The only places in which wood has been used are for window frames, sash and trim, and for doors and door frames. In some places wooden treads have been added to the concrete treads of the stairs, but this is not uniform throughout the entire plant. The design of the concrete details are under the Ransome system and were worked out by the firm of Ransome & Smith, of New York City. E. L. Ransome personally directed the construction. In this system the steel reinforcement is entirely of square twisted-steel bars of a size determined by the needs of the design.

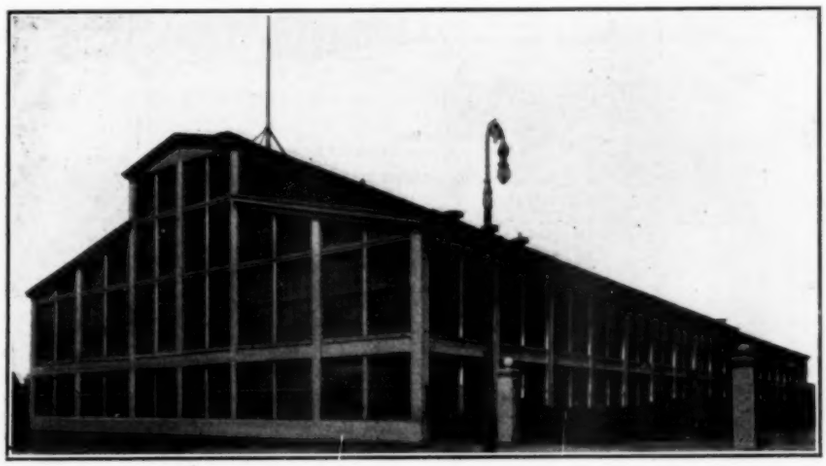


FIG. 5. THE FOUNDRY

FIG. 6. THE POWER STATION

Fig. 7 shows a typical cross-section of one of the main buildings and gives the size of the sections of columns, floors, beams, girders and other members, together with the location and size of the reinforcing steel bars. The building is divided into 20-foot bays and the interior columns are octagonal in shape; beginning with the upper floor and reading downward they are 14 inches, 14 inches, 18¼ inches and 22 inches across the flats, respectively. This type of column is a little unusual, the ordinary types being square or round.

The foundations are in the nature of footings under the exterior and interior columns and are carried down to a depth determined by the character of the soil.

The design of the floor members is such that the same core boxes were used for each story. Thus the concrete of these members is of the same general outside dimensions while difference in strength is obtained by changing the steel reinforcement.

Each of the main buildings *A* and *B* is divided structurally into three independent sections, two 260 feet long and one 300 feet long. This is to care for the element of expansion. This joint in the original plant, that is, between the two 260-foot sections, has varied ½ inch in width between a building temperature of midwinter, and an ordinary factory temperature of say 69 degrees Fahrenheit.

The concrete details of the connecting buildings, the foundry, forge shop and power station, do not follow the typical design of Fig. 7, but were worked out for their particular needs. In some parts a heavy, flat, slab floor is used instead of the beamed construction. The entire floor area of all the buildings is a little less than 17 acres.

Method of Construction

The method of construction employed in general is what is known as "monolithic," that is, the forms of each floor level were set up as a unit and the concrete forming the columns, girders, beams and floor were poured at one time, giving a mass which was thoroughly bonded and tied together throughout its level. Fig. 8 shows a view of the forms after they had been prepared for pouring the concrete. The deep groove is for a main girder, with an interior column form at about midway of its length. Fig. 9 shows a view beneath the forms and gives an idea of the method employed in bracing and supporting them. The vertical box near the center of the view is for an interior column.

Fig. 10 shows the forms in place for the lowest story of building *A*, in a condition ready to pour the concrete. In the background is a tower of the cableway. The material for the original construction was handled by this means. The cableway covered the entire field of operations for the buildings of the first, second and third rows.

In Fig. 11 we see the forms being started for the second story of building *A*, the first story having been poured. This shows the method of building up the

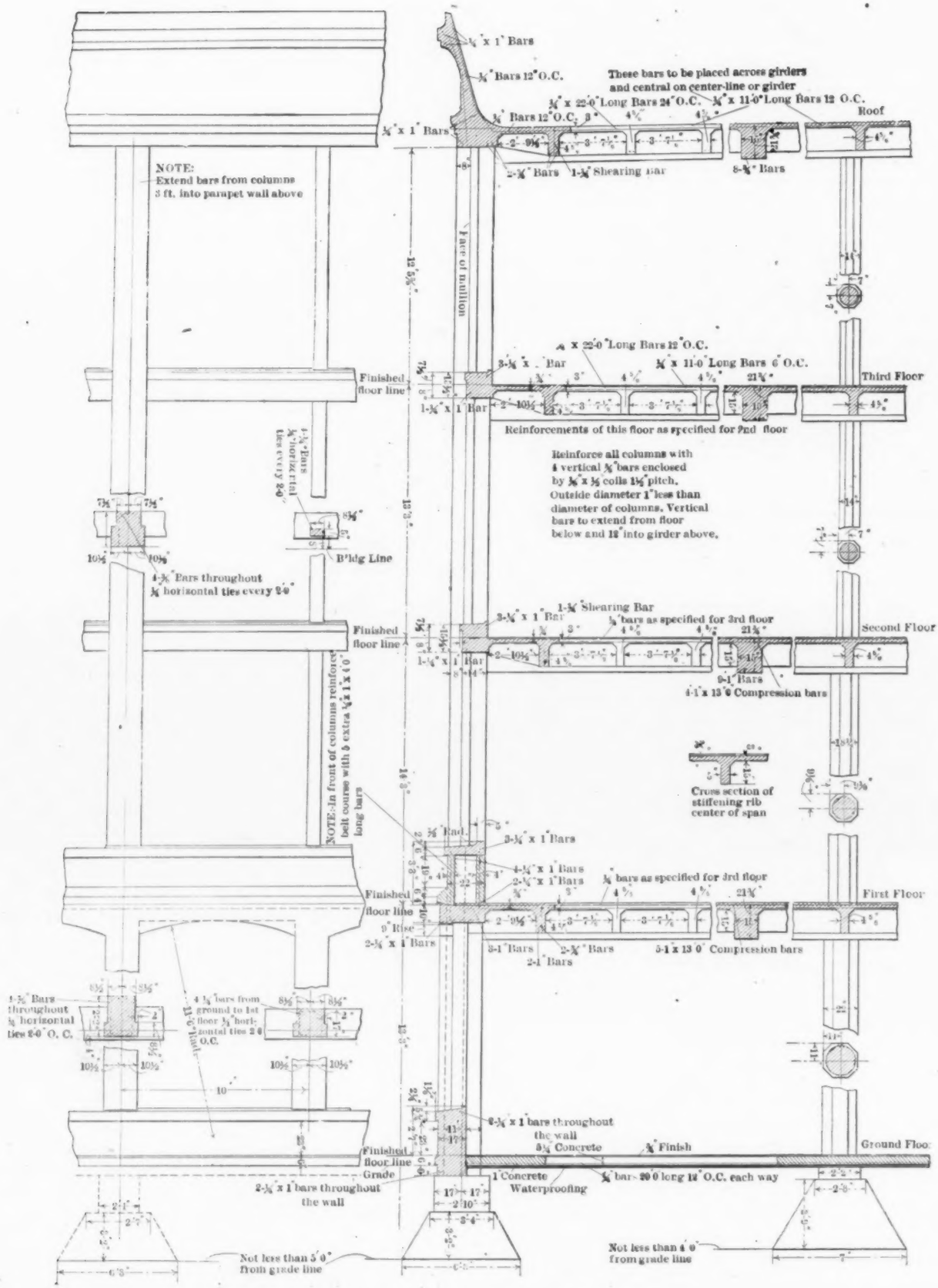


FIG. 7. TYPICAL CROSS-SECTION OF MAIN BUILDINGS

forms out of panels, and unit sections. Two rows of steel cages and reinforcement for the interior columns will be noticed as cobwebby outlines running the length of the building.

This method of construction was departed from in building the addition to the power station. Here a method called the "unit system" was used. The various members, girders, columns, beams, roof slabs, etc., were cast in forms on the ground, hoisted into place and bonded together. The prediction is being made by some concrete experts that this method will come into extensive use in preference to the monolithic. Its advantages are said to be a lower cost and a shorter time in construction.

Before leaving this phase of the plant the power-house roof should be mentioned. It has two clear spans, one of 44 feet, and the other of 46 feet. When built these were among the longest concrete spans in this country.

It may not be out of place to state that concrete construction requires the closest attention to details. The cement must be fine, and with the proper qualities in regard to strength, time of setting, etc. The sand must be sharp and clean, and the stone must be hard and not porous.

All of the material entering into this plant was carefully inspected and tested. The cement test followed very closely the recommendation of the United States War Department, omitting, however, the boiling test. All of the concrete was carefully inspected when placed, as well as its steel reinforcement. Test cubes were taken at frequent intervals and broken after 7 or 28 days of setting.

The concrete mixture was made from American portland cement, sand and crushed stone or natural gravel. A large amount of natural gravel was used in the original plant built in 1904, but in the extension built in 1906 practically nothing was used except crushed stone. The reason for this was that in front of the buildings was a large ledge. This ledge was blasted out, crushed, and gave on the spot an excellent building material for the large aggregate of the concrete mixture. In the entire plant there have been used about 100,000 barrels of portland cement.

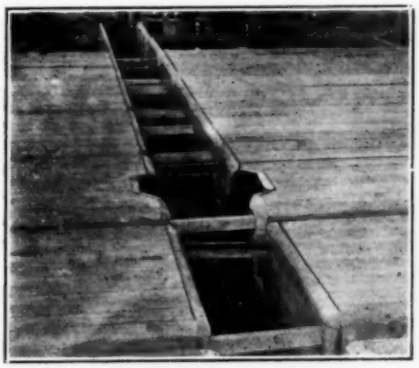


FIG. 8. A GIRDER FORM READY TO POUR

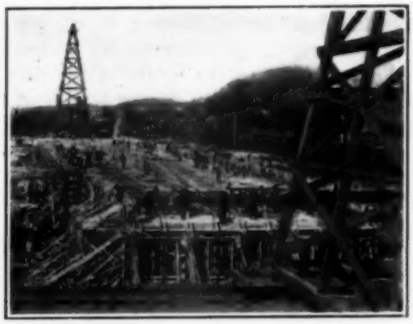


FIG. 10. FORMS FOR A FIRST STORY

FIG. 9. BRACING FOR FORMS

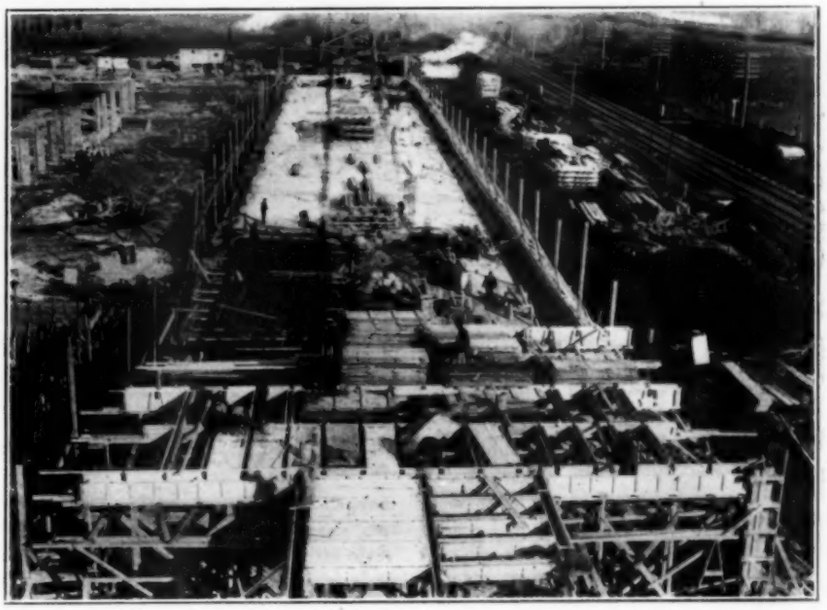


FIG. 11. FORM CONSTRUCTION FOR SECOND STORY

Exterior Finish

The exterior finish of the concrete is what is known as a bush-hammered finish. That is, the natural surface of the concrete left by the form is roughened by bush hammers or pneumatic hammers. A space of about 1¼ inches is left unfinished from all edges of columns or walls, in order that there will be no injury to these corners during the hammering operation. This adds a distinctive feature to the type of finish. This finish is shown by Fig. 12. The buildings surely present a most pleasing appearance if seen in the time of the year when grass and foliage are green. The light gray of the buildings and their extent make them stand out against the surrounding hillside and trees in a picture which is perhaps unusual in a manufacturing plant.

Floors and Floor Finish

One question frequently asked in connection with a concrete machine shop is: Are the concrete floors objectionable to the employees? The experience of the United Shoe Machinery Company has been that the employees do not object to the floors. The finish on the floors is what is known as "granolithic." It is a finish similar to that used in sidewalk work. This concrete finish, which is a very rich cement mixture about ¾-inch thick, is troweled to a glass-like surface. This surface is apparently uninjured by oil. Careful investigation of concrete floors on such jobs as screw-machine work or milling work, where a great deal of oil had been used for a period of 2 years, failed to show any penetration of the oil which would injure the concrete. The floors are easily kept clean because they do not absorb oil or other liquids,

and in case any gum is formed on the surface it can be readily removed by the usual cleansing agents.

Natural Light

As we have mentioned, the noticeable feature of the plant is the excellent provision for admitting natural light. On the two upper floors the windows run from floor to ceiling, and with the exception of the wall columns which contain the heating flues, the wall columns are very small in size; thus giving 90 per cent. of the wall area for glass. On the two lower floors is a 3-foot curtain wall. The windows at this point run from the top of this curtain wall to the ceiling. Thus these floors have light almost as good as the two floors above.

The windows are glazed with clear sheet glass set in very heavy sashes. In the older part of the plant the sashes were hung with weights, but in the newer part the upper and lower sashes are hung together, and when one is raised, the other is lowered. This is apparently a somewhat better device than the use of weights, for the large and heavy weight-hung sashes have a tendency to bind.

Skylights have been used very sparingly There is one skylight on the main building *A*, near the southern end, as will be noted by referring to the cut. This is over the inventors' room, a department of small individual rooms so arranged that it was impossible to get the best of light from the exterior windows. There are also a few skylights over the toilet-room wings, made necessary because of the deck effect which has been spoken of. The windows throughout are curtained with heavy shade curtains, this being only one of the features which have been worked out for the comfort of the employees.

Fire-resisting Features

Throughout the stair wells and in the rooms in the toilet-room wings, *A B S*, *A B N* and *A B X*, which are devoted to tool storage, a metal frame, metal sash and wire glass have been used in place of wooden frames and wooden sash, because of their fire-resisting qualities.

All of the door openings between the main buildings and the passageways, and between the passageways and the elevator wells and stair wells, are provided with fire-proof doors; otherwise the doors of the plant are of wood. An interesting feature in connection with these fire-proof buildings is the fact that the owners do not carry insurance upon either building or contents, relying upon the fire-resisting type of the building construction, and upon the fact that very little wood or any other inflammable material has been used in connection with the factory equipment. Sprinklers have been installed over departments using wood or handling wood in storage, such as the pattern shop and the boxing room; otherwise the plant is devoid of such service.

In the older construction the elevator wells were placed inside of the buildings themselves, that is, running through from floor to floor. In the extension, however, these wells were placed in the wings. In the wells which run between floor and floor the surrounding walls are of wire glass, set in concrete frames and held in place with copper-covered stops.

As indicated on the plan Fig. 1, a tunnel connects the power house with all of the other buildings. This tunnel and the chambers which it enters under buildings *A B S*, *A B N*, *B C*, *A B X*, and the storage basement under building *E*, are constructed entirely of concrete, but because their floor levels were considerably below the level of mean high tide, it was necessary to introduce water-proofing. This was done by coating the exterior of the walls with several layers of tarred felt mopped on with asphalt. The results from this water-proofing have in the main been very satisfactory. If seepage does take place it is cared for by steam-driven sump pumps. During the building of the plant several schemes had to be worked out for supporting fixtures from the concrete ceilings. These devices have been described on pages 367 and 368. The careful working out of such devices unquestionably adds to the success or failure of such a building when used for machine-shop purposes.

Interior Finish

An interior view is shown by Fig. 13. In the main buildings the ceilings, walls and columns down to a hight of about 6 feet from the floor are whitewashed with an alum whitewash. From that point down to the floor on the columns and walls the finish is a gray water-color paint separated from the whitewash by a band of dark brown. This, of course, gives a very light ceiling to reflect and diffuse light throughout the room, and the darker color at the base is not so readily soiled by coming in contact with the clothing of the workmen. The concrete surfaces were not smoothed up before this finish was applied, but were left as they were when the forms were stripped.

The walls of the toilet, locker and wash rooms in the connecting buildings are plastered, and finished at the bottom with a sanitary base. Above this base for a hight of 6 feet the plaster is painted with white enameled paint, giving a hard, white, glossy surface, easily kept clean. Above this a flat white paint is used. The two kinds of painting are separated with a narrow, raised, plaster molding.

The wood finish and trim is cypress, hard pine and plain red oak, finished with a "mission" stain. The wooden ceilings of *D* and *E* are painted a concrete color with a water-color paint. This same color is used on the steel work of the roofs of these buildings.

FIG. 12. EXTERIOR FINISH OF THE CONCRETE

Success of the Concrete Construction

The question is frequently asked, How successful is concrete construction for machine-shop buildings? Probably the best answer which can be given to this question in connection with the plant of the United Shoe Machinery Company is the fact that while the original plant was built in the years 1903 and 1904, during the year 1906 a 60 per cent. addition was built of exactly the same type and construction as that of the original plant. Concrete construction has been successful and has been very successful, as exemplified in the building and use of this plant at Beverly.

The question of cracking has often

been brought up against concrete construction. As far as this plant is concerned, this feature has given little trouble aside from a limited number of cracks which appeared in the floors of the original construction. These were caused probably by shrinkage and were easily corrected. The floor loads for which the plant was designed were 250 pounds per square foot for the second-floor level and 200 pounds per square foot for the two upper floor levels, the lower floors, of course, being directly on the ground. These floors have been loaded to the limit of their design and in many cases overloads on small areas have been noted, but in no cases has trouble or failure occurred.

Only one beam has been broken in use, and that was caused by an accident. A punch-press fly-wheel weighing 1800 to 2000 pounds dropped from a hight of about 4 feet and struck the concrete floor directly over a beam. The concrete of the beam was shattered, but the steel work was uninjured, and it was a very simple matter to remove the concrete which was broken and replace it by a fresh mixture. The result is probably as strong as the original beam.

FIG. 13. INTERIOR VIEW SHOWING FINISH

The experience of this plant shows that concrete construction can be made succesful for manufacturing concerns whose product is similar to that of the United Shoe Machinery Company, embodying as it does inexpensive first cost, fire-resisting qualities, and in a very great measure the element of durability.

It is a pleasure to acknowledge the courtesy of the United Shoe Machinery Company in furnishing facilities for collecting the data necessary for this article and others which are to follow about this plant. While I am well acquainted with the details of its design and construction, having been with the work from its inception until a very recent date, still the kind coöperation of the company made the publication of these data possible. I am especially indebted to the general superintendent of the plant, M. B. Kaven, in this connection.

Designing for the Future

By S. H. Bunnell

It is safe to say that no man knows today as much as he will know tomorrow. It sometimes appears to a designing engineer when going to a new employment that his predecessors must have been remarkably stupid men, and that they could not have had the foresight that he himself would have exercised. It is also safe to say that the same man will appear just as stupid to any successor, who tries to fit a cylinder an inch larger on a frame designed originally for what was then supposed to be the limit of cylinder diameter. It is worth while to give careful thought to the possibility of future growth or modification in making designs and patterns for any class of machinery where changes may be expected.

It is almost always the case that a number of sizes will be called for, and the designer of the first machine should lay out in advance the probable scope of sizes and carefully arrange his design to cover a proper range, thus leaving no little gap either above or below, which he will later need to fill by awkward subterfuges. If a steam engine is on the drawing table the sizes should be figured, not for the cylinder dimensions and pressure to be then used, but for the largest cylinder which the frame and working parts are ever to carry, and all connections and bearings should be of a proper size to handle the work of this cylinder. There will then be no necessity of stretching the design to cover something a half inch bigger, particularly if the designer has taken care to provide liberally for clearances.

The various main parts of a machine which must fit together and which may be used with other parts to make combinations for different sizes, as for instance the cylinder and frame of a steam engine, should be designed with a view to easily making necessary combinations as required. It is convenient to have the flange of an engine frame at the cylinder end made loose in the pattern, to provide for changes in diameter. Steam cylinders should generally be made so as to be readily adapted to more than one size of frame, and in many cases, the patterns may be divided so that strokes may be changed without difficulty. The small parts, such as valve-rod connections, gears, miscellaneous flanges, bearing caps and the like, which run through a line of machines, are most conveniently standardized in such a way that they may be used with other machines for combinations. Designers often find that thirty or forty miscellaneous patterns for say eccentric-rod boxes may be done away with in favor of a set of half a dozen which will answer all purposes. The value of this in reducing stock carried is considerable, and such parts may be made up in lots at a saving of expense and issued from the store room as required.

It is said that one of the original makers of the Constitution of the United States ridiculed the remark of another regarding the opinion which would be held of the Constitution in one hundred years. It seemed to him that nothing that man could make could be expected to last one-tenth of that time without extensive changes. In a country of change, we are learning the opposite conclusion, and while improvements and modifications are always in order, it is possible by thinking for the future for a careful designer to save a heavy cost for unnecessary drawings and patterns, and to plan his work so that his designs and their component parts may be readily worked into later and different combinations.

Thirty expresses covering 100 miles or more without a stop now run in and out of Paddington station daily. The station is 700 feet long and 258 feet wide; it covers about eight acres, and it involved an outlay of £650,000. There are nine platforms, accommodating some 300 trains per day.—*Mechanical World.*

Tooth Relief for Milling Cutters —A Criticism

By John Edgar

Under the title "Tooth Relief for Milling Cutters," H. T. Millar writes, at page 486, on the possibility of producing with a flat-face wheel a convex face on the ground land of the milling cutter. I wish to differ with him on this point.

The style of wheel shown by Mr. Millar, in Fig. 1 of his article, is not practical for use in grinding the relief of a spiral-tooth cutter; as proof I present Fig. 1, in which *A B* is to represent the face of the wheel. It will be seen that such a wheel, of any width of face and inclined to give the necessary clearance to the cutting edge, would grind off the cutting edge itself, as the cutter is passed before the wheel, and given the rotary motion by contact with the guiding finger before the tooth section reaches the position *a*. This is clearly seen by an examination of the figure, where the line *A B* is seen to run inside of the periphery of the cutter from *a* to *b*. This at once shows the impossibility of using a wheel such as Fig. 1 of Mr. Millar's article suggests.

Fig. 6 of his article shows a wheel of different shape, but without any excuse from him for its introduction into the discussion. This wheel is no doubt used in order to get around some of the objections of the former shape, which I have shown is impossible for use in this connection. This second style wheel, shown in Fig. 6, while it does to some extent cure the bad effects of the face wheel, does so by presenting a convex face with contact at one point on its periphery, giving the concave land as produced by the disk wheel. It may be conceded that by this style wheel we may form a less concave land with a much smaller wheel than would be possible with a wheel of the disk type.

Convexity of the Tooth

There is another point that, independently of the one above, would tend to contradict Mr. Millar's theory, and, that is, the convexity of the tooth along its face, parallel with a tangent to the helix, caused by the twist of the same. This is shown in Fig. 2, where we have the tooth *c' g e'* drawn at the angle of the helix α and from which is projected the elevation along the cutting edge, showing the convex shape of the same. In order to present the point which this figure is to emphasize, viz., that a broad contact of tooth and wheel is impossible, there is shown a section of the wheel in contact with the tooth profile, which shows a contact at *d* only. Therefore the tooth would take the shape of the wheel at the point. Contact either side of this point, due to stock to be removed, is possible on one side *d* only, having no effect whatever on the shape of the land. This upsets the theory of broad contact that produces the numerous angles forming the convex relief.

Here in Fig. 1 may be seen another contradiction of the theory of convex relief. In feeding the cutter along in front of the wheel the tooth is given a combined longitudinal and rotary motion guided by the finger. This brings every portion of the tooth in contact with the wheel face at any single point, and since we may conclude that the point of the wheel that lies closest to the center of rotation of the cutter will be the point that determines the shape of the tooth, we may, in Fig. 1, take this point as the point of tangency of the line *A B* and an arc struck from the center of the cutter as shown at *f*. The arc thus drawn shows that the contact does not continue to the point *a*, and while the land thus ground would be convex in shape, the cutting edge would have no relief, as the convexity is cylindrical in shape about the axis of the cutter. Therefore we have in this but another form of cylindrical grinding.

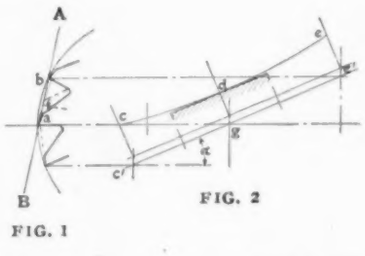


FIG. 1

FIG. 2

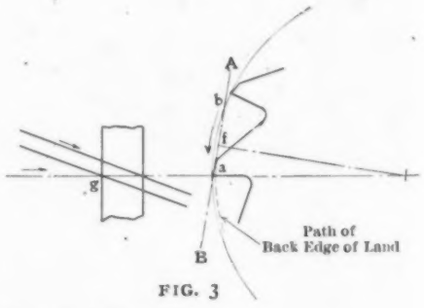


FIG. 3

TOOTH RELIEF WITH FLAT WHEELS

How Conclusions Were Reached

In coming to these conclusions it was assumed that the wheel was set so as to straddle the point *g*, Fig. 2. By changing these conditions slightly we may obtain further evidence of the impracticabilty of Mr. Millar's theory. These changed conditions, as represented in Fig. 3, where the wheel is shown set to one side of the point *g*, so that contact with the cutting edge above the horizontal plane is impossible, therefore overcome the objections so far set forth due to the interference from *a* to *b*. A casual inspection of Fig. 3 might lead one to expect that as the work was moved along longitudinally and with the rotary motion the tooth would be presented to the wheel surface at continually changing angles, producing the much desired convex surface to the land. But a closer inspection shows that this is impossible; that the only position in which the wheel and tooth touch is at the section *a*, and that the wheel only grinds the cutter with the edge at *g*, producing an angle of relief equal to that at which the wheel is set. It is easily shown by drawing an arc representing the travel of the tooth at any point along the land that the wheel does not remain in contact after the tooth leaves the position at *a*. It is further shown that the land would have to be greater than the amount *a f* before any portion would remain in contact with the wheel for more than an instant while the cutter is in motion, and that any amount in excess of *a f* would be ground cylindrical in shape with the axis of the cutter as a center.

Theory of Convex Lands

In Figs. 1, 2 and 3 are given the reasons that seem to show that the theory of convex lands is wrong, and that it is practically impossible to produce such lands by the means considered. In Fig. 6 of Mr. Millar's article is shown a wheel which should be of special value in cutter grinding. It is not quite clear from his drawing just how the cutter is set, that is, whether it is set to cut across the face, as in Fig. 4, or as in Fig. 5 of this article. That it is set to cut across the face is evident; but if set as in Fig. 4, we have a contact that is limited in extent and has less tendency to heat and draw the temper of the steel than when set as in Fig. 5, where the contact may be assumed to be the full width of the wheel face, notwithstanding the convexity of the surface as shown, for the depth of stock removed may be enough to counteract this convexity and cause heating even when it would not have any effect on the shape of the land produced. The difficulty of using the wheel, as shown in Fig. 5, would be the inability of setting the wheel spindle so as to obtain the desired position, as the ordinary cutter grinder is made with the cutter-spindle and wheel-spindle axes in parallel horizontal planes. Modifications in present designs would, of course, be necessary.

The Disk Wheel

The disk wheel is so handy, and its use so common that few ever connect any other style wheel with cutter grinding. As it seems to answer the purpose, we have but little occasion for complaint. Fig. 7 shows the usual manner in which

this wheel is used. The concave land that results is, of course, dependent on its diameter for the depth of concavity. Always use as large a wheel as you can without interfering with the adjacent teeth, in order to produce as flat a land as possible.

Fig. 6 is a suggestion of a method that may interest some who desire to obtain the flat land. The objection with this manner of setting is that the wheel is liable to develop "ruts," and would need frequent dressings. This rutting can be overcome to some extent by swinging the wheel center a little at an angle with the perpendicular to the cutter-support axis, causing the wheel to cut across the tooth.

Use of the Cup Wheel

The cup wheel, which was developed primarily to sharpen reamers, has come into quite common use for performing similar operations on milling cutters. Fig. 8 shows how it could be used to grind a spiral mill. It has the serious objection

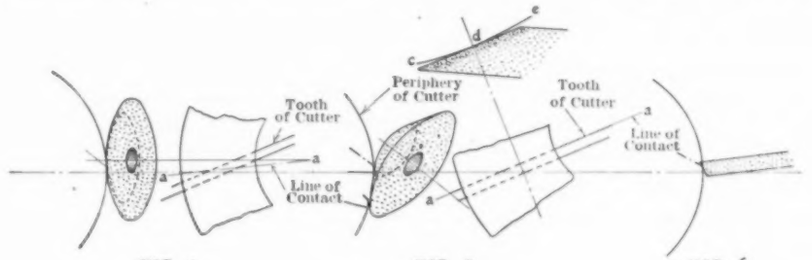


FIG. 4

FIG. 5

FIG. 6

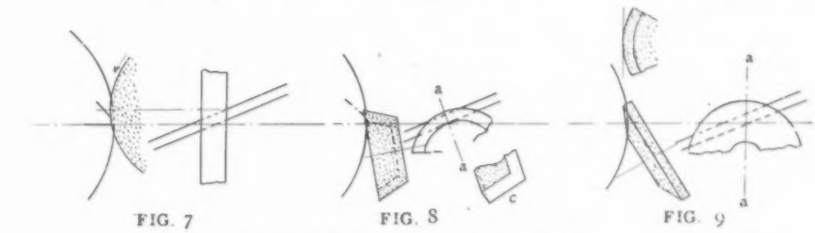


FIG. 7

FIG. 8

FIG. 9

USING WHEELS OF VARIOUS SHAPES

that it presents a very large area of surface in contact with the tooth, tending to heat and draw the temper of the steel in a much greater degree than any other wheel so far mentioned. That it is impractical for use in grinding this style cutter is evident without any remarks. The cutting face of the cup wheel may be changed, as shown at *c*, Fig. 8, and it then may be used in a manner similar to Figs. 4 and 5, with the same results.

Fig. 9 shows another use for the wheel shown in Figs. 4 and 5, only in a modified form. With a wheel of this shape, and set as suggested in the figure, we would have a wheel that would produce a flat land, and still be free from the objectionable heating effects of the cup wheel and also, to some extent, be free from the rutting so pronounced in the case of the disk wheel when used as in Fig. 6. We might run up against the same difficulties that were mentioned in regard to the use of the setting, as in Fig. 5.

Milling Cutters Past and Present

It might be well to look over the tendency of present practice in the design of milling cutters, in comparison with practice as it was found a few years ago. The progress in the art of milling has been so rapid that it seems but yesterday that we had only the universal-type machine nibbling away at the lightest of work in the tool room, with cutters in which it seemed to be the object to get as many teeth per inch of circumference as was possible, somewhat on the principle of the file. But since the advent of the milling machine it has been found that in order to get better results the cutters must have more care in their design, so that today we are striving to obtain cutters with the least number of teeth and maximum chip room. Another feature that has entered into the design of latter-day cutters is the width of the land of the tooth. This is now made about three thirty-seconds to one-eighth of an inch wide, backing up the cutting edge and furnishing a volume of metal at the cutting point to absorb heat. Heat and vibration are the elements that enter most into the destruction of a fine cutting edge.

Carting Heavy Machinery

The problem of getting heavy machinery into its proper place is often more serious than making it in the shop where the facilities are at hand. A low pressure cylinder for a Corliss engine which weighed 27 tons recently gave all kinds of trouble in carting from the freight yard to the power station. When loaded on a heavy truck with tires five inches broad, ten horses could not pull it and it was drawn by a windlass much as houses are moved. It was so heavy that the wheels would sink to a depth of four inches in a macadam road if left standing and it was necessary to lay down iron plates to prevent ruining the roads. Cartage of this kind costs money.

System in Dressing Lathe Tools

By J. F. Sallows

In some factories the system for replacing a lathe tool is something like this: A lathe hand breaks a tool; he throws it aside, probably on the floor, looks for another one and not finding it tries to borrow from his neighbor. Still unsuccessful he goes to his foreman for a new tool. He then walks to the smith shop and tells the tool dresser just what he wants and just when he wants it. On his way he visits with three or four of his friends and altogether wastes an hour or more of the company's time.

If this is repeated by a number of men it means a considerable loss. Besides, the tool dresser is bothered and hindered by having men coming to him and waiting for tools to be tempered or dressed.

I have been the tool dresser in several large factories and have introduced a system in this connection which has worked well. In the machine shop or lathe department is placed a wooden cupboard. This is divided into a number of shelves, ten or twelve. The upper half is open, while the lower section is closed by a door provided with a lock. The keys of this lock are held by the foreman and tool boy. When a lathe hand wants a new tool he returns the old one to an upper shelf of the cupboard and applies to his foreman for a new one.

The boy takes the returned tools to the tool dresser and brings back the repaired tools to the locked section of the cupboard. A sketch for a special tool can be put on one of the shelves with the old tools and will go to the dresser in the regular way.

In the smith shop is a box into which the boy puts the tools to be dressed and another for tools ready to be taken back to the job.

Water Under Pressure

Regarding the various schemes for utilizing the earth's heat by boring into the crust and boiling water at great depths, George N. Cole writes as follows: "Water at the depth of 12,000 feet would be under a natural pressure due to head of 6000 pounds per square inch. We will have to depend on equations I have no time to look up to see what the temperature would be at which water under that pressure would start to generate steam. Tables fail me for these pressures. Under a pressure of 300 pounds per square inch water will not generate steam until it is raised to a temperature of 421.83 degrees F. (which is about 216.6 degrees C.). So you see that you have to arrange a power station at the bottom of your drive to . . . remove the pressure."

Computation Table for Regular Polygons

Making It Easy to Find Area, Length of Side, Diameters of Inscribed or Circumscribed Circles, Etc., from Such Dimensions as Are Known

BY W. L. BENITZ

The object of the two tables appended to this article is to simplify the necessary calculations for any required dimensions of regular polygons.

If the area, or any dimension, of a regular polygon of a specified number of sides is given, all the other dimensions are thereby fixed in amount, and the proportion which the known part bears to each of the unknown parts will vary with the number of sides of the polygon. A knowledge of trigonometry is a requisite in determining the required proportions of these parts, and the accompanying tables were prepared not only to facilitate the trigonometrical work, but at the same time to simplify the process down to plain multiplication, or, where the area is the given dimension, to square root. The case in which the number of sides is required cannot be directly solved by trigonometry, but is easily found by means of the tables.

Table I gives the symbols by which the various parts are designated, as well as all the necessary formulas needed for any computation.

In addition to the symbols indicated at the top of Table I, there appear the letters F, M, B, K and H, which are selected from Table II for the proper value of N, the number of sides of the polygon, which heads the first column.

These letters represent the following quantities:

$$F = N \tan. \frac{180^\circ}{N},$$

$$M = 2N \sin. \frac{180^\circ}{N},$$

$$B = \frac{1}{N} \operatorname{cosec}. \frac{180^\circ}{N},$$

$$K = \frac{N}{4} \cot. \frac{180^\circ}{N},$$

$$H = \frac{N}{8} \sin. \frac{360^\circ}{N}.$$

The logarithms of these quantities are given in each succeeding column for convenience when logarithmic calculation is used.

Examples

The use of the tables may be partly illustrated by the following simple applications:

Example 1. What size octagonal steel will have a sectional area of 2 square inches?

We know $A = 2$, $N = 8$ and must find d. In Table I we run down the column headed A until we find an equation with the required term d on the left-hand side, giving the formula:

$$d = \frac{4\sqrt{AK}}{N}.$$

The value of K is taken from Table II in the line beginning with $N = 8$, giving us $K = 4.82843$. Substituting these values of A, K and N in the formula gives:

$$d = \frac{4\sqrt{2 \times 4.82843}}{8}$$

$$= \frac{\sqrt{9.65686}}{2} = 1.554,$$

which is the proper distance across the flats to give a sectional area of 2 square inches.

Example 2. What is the size of the round bar from which the octagonal bar of the preceding example could be milled?

It is now required to find D, with $N = 8$ and $A = 2$, as before, or we may use the determined value of $d = 1.554$ inches instead of A. If the latter is selected we know d, and, selecting the last formula from Table I in the column headed d, we have $D = B\ F\ d$. B and F are selected as before, but if we use logarithms this time our values will be taken from the tabulated logarithms of those quantities, giving us in the line for $N = 8$, Table II, $log.\ B = 1.514070$, $log.\ F = 0.520314$ and $log.\ 1.554$ (from table of logarithms) $= 0.191451$.

Then,

$$log.\ D = log.\ B + log.\ F + log.\ d$$

$$= 1.514070 + 0.520314$$

$$+ 0.191451 = 0.225835.$$

$\therefore$ $log.\ D = 0.225835$ and $D = 1.682$ inches, the diameter of round rod necessary.

Example 3. What is the area of a segment of a circle 66 inches diameter lying between the circumference and one side of an inscribed polygon of five sides?

The area required, which is similar to the shaded area in the figure of Table I, will be one-fifth of the difference in areas between the circle and the inscribed polygon of five sides. Knowing D, we find the area of the polygon from the formula $A = D^2H$, using the value of H for $N = 5$, which is 0.59441. The area of polygon is, then, $A = 66^2 \times 0.59441 = 2589.3$ square inches. The area of the circle is $\frac{\pi}{4} 66^2 = 3421.2$ square inches. Taking one-fifth of the difference we have:

$$\text{Area of segment} = \frac{3421.2 - 2589.3}{5}$$

166.38 square inches.

ple 4. If each side of a polygon is 4 inches, how many sides must it have to make the area 99 square inches?

In this case both $C = 4$ and $A = 99$ are known, and N is to be determined. Selecting the formula for A when C is known, we have $A = KC^2$; solving for K gives:

$$K = \frac{A}{C^2}.$$

Substituting the known values of A and C gives:

$$K = \frac{99}{4^2} = \frac{99}{16} = 6.1875.$$

Running down the column headed K, in Table II, we find the nearest value to this is 6.18182, which corresponds to the value 9 for N. The figure would then have to have 9 sides.

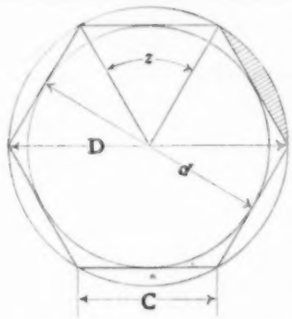
These are only a few of the many applications that may be made of the tables, and as indicated by the number of formulas, there may be twenty different problems stated, all of which are taken care of. They are also adapted to the solution of isosceles triangles in which the vertical angle approximates that in column z, Table II.

[Furthermore, it is, of course, evident that the *angle between adjacent sides* of a regular polygon may be obtained by subtracting from 180 degrees the angle z given in the last column of Table II.—Ed.]

American Telephone Statistics

The report of the American Telephone and Telegraph Company for the year ended December 31 last shows that the net output of the telephones for 1906 was 1,409,578, making the total number of instruments in the hands of operating companies, not including independent concerns, 7,107,836. The gross revenues for the year of all the Bell companies in the United States was $114,000,000. The so-called independent companies seem to have made no relative gain, except in a few localities. The amount expended for maintenance and reconstruction during 1906, independent of construction, by all the Bell companies, was $32,814,568. The scrap value of the lead and copper in the lines and cables alone of these concerns is said to be $80,000,000. As an indication of the extent to which the Bell companies have built for the future may be mentioned the fact that at the present time no less a sum than $25,000,000 is invested in circuits or cable that is not yet in use.

z = Angle subtended at center by side.
P = Perimeter of polygon.
C = Length of one side.
A = Area of polygon.
N = Number of sides.
d = Diameter of inscribed circle.
D = Diameter of circumscribed circle.



To Find \ Knowing	P	A	C	D	d
P		$P = 2\sqrt{FA}$	$P = CN$	$P = \frac{MD}{2}$	$P = Fd$
A	$A = \frac{KP^2}{N^2}$		$A = KC^2$	$A = HD^2$	$A = \frac{Fd^2}{4}$
C	$C = \frac{P}{N}$	$C = \frac{2\sqrt{FA}}{N}$		$C = \frac{MD}{2N}$	$C = \frac{Fd}{N}$
D	$D = BP$	$D = 2B\sqrt{FA}$	$D = NBC$		$D = BFd$
d	$d = \frac{4KP}{N^2}$	$d = \frac{4\sqrt{AK}}{N}$	$d = \frac{4KC}{N}$	$d = \frac{2MKD}{N^2}$	

TABLE I. SYMBOLS AND EQUATIONS

The following factors are used in the calculations, their values being found in Table II:

$$F = N \tan. \frac{180°}{N}; \quad M = 2N \sin. \frac{180°}{N}; \quad H = \frac{N}{8} \sin. \frac{360°}{N};$$

$$K = \frac{N}{4} \cot. \frac{180°}{N}; \quad B = \frac{1}{N} \operatorname{cosec}. \frac{180°}{N}.$$

N.	F.	Log F.	M.	Log M.	H.	Log H.	K.	Log K.	B.	Log B.	z
3	5.19615	0.715682	5.19615	0.715682	0.324760	$\bar{1}.511562$	0.433013	$\bar{1}.636501$	0.384900	$\bar{1}.585348$	120°
4	4.00000	0.602060	5.65685	0.752575	0.500000	$\bar{1}.698970$	1.00000	0.000000	0.353553	$\bar{1}.548455$	90°
5	3.63271	0.560281	5.87785	0.769219	0.594410	$\bar{1}.774086$	1.72048	0.235649	0.340260	$\bar{1}.531811$	72°
6	3.46410	0.539501	6.00000	0.778151	0.649519	$\bar{1}.812502$	2.59808	0.414652	0.333333	$\bar{1}.522879$	60°
7	3.37100	0.527750	6.07435	0.783500	0.684103	$\bar{1}.835122$	3.63393	0.560377	0.329254	$\bar{1}.517531$	51°25′43″
8	3.31371	0.520314	6.12204	0.786960	0.707107	$\bar{1}.849485$	4.82843	0.683806	0.326341	$\bar{1}.514070$	45°
9	3.27573	0.515308	6.15636	0.789324	0.723136	$\bar{1}.859220$	6.18182	0.791117	0.324867	$\bar{1}.511706$	40°
10	3.24920	0.511778	6.18084	0.791012	0.734732	$\bar{1}.866120$	7.69421	0.886164	0.323607	$\bar{1}.510018$	36°
11	3.22980	0.509187	6.19811	0.792259	0.743380	$\bar{1}.871211$	9.36566	0.971538	0.322679	$\bar{1}.508771$	32°43′38″
12	3.21539	0.507234	6.21166	0.793207	0.750000	$\bar{1}.875061$	11.1962	1.049069	0.321975	$\bar{1}.507823$	30°
13	3.20420	0.505720	6.22219	0.793943	0.755173	$\bar{1}.878047$	13.1858	1.120107	0.321430	$\bar{1}.507087$	27°41′32″
14	3.19543	0.504529	6.23062	0.794532	0.759293	$\bar{1}.880410$	15.3344	1.185667	0.320995	$\bar{1}.506499$	25°42′51″
15	3.18835	0.503566	6.23735	0.795000	0.762631	$\bar{1}.882315$	17.6424	1.246557	0.320649	$\bar{1}.506030$	24°
16	3.18260	0.502782	6.24280	0.795386	0.765367	$\bar{1}.883870$	20.1094	1.303398	0.320364	$\bar{1}.505644$	22°30′
17	3.17788	0.502138	6.24754	0.795709	0.767636	$\bar{1}.885155$	22.7353	1.356700	0.320126	$\bar{1}.505321$	21°10′35″
18	3.17389	0.501591	6.25133	0.795973	0.769545	$\bar{1}.886234$	25.5202	1.406894	0.319932	$\bar{1}.505057$	20°
19	3.17061	0.501130	6.25455	0.796196	0.771166	$\bar{1}.887148$	28.4654	1.454318	0.319767	$\bar{1}.504834$	18°56′51″
20	3.16769	0.500743	6.25738	0.796392	0.772543	$\bar{1}.887922$	31.5688	1.499258	0.319623	$\bar{1}.504638$	18°
21	3.16523	0.500406	6.25975	0.796557	0.773729	$\bar{1}.888589$	34.8316	1.541974	0.319502	$\bar{1}.504473$	17°8′34″
22	3.16317	0.500123	6.26195	0.796710	0.774763	$\bar{1}.889169$	38.2527	1.583063	0.319389	$\bar{1}.504330$	16°21′49″
23	3.16129	0.499864	6.26390	0.796830	0.775668	$\bar{1}.889676$	41.8342	1.621532	0.319301	$\bar{1}.504200$	15°39′8″
24	3.15966	0.499640	6.26526	0.796939	0.776457	$\bar{1}.890118$	45.5745	1.658722	0.319221	$\bar{1}.504091$	15°
25	3.15824	0.499444	6.26666	0.797036	0.777156	$\bar{1}.890508$	49.4738	1.694376	0.319149	$\bar{1}.503994$	14°24′

TABLE II. FACTORS AND THEIR LOGARITHMS, AND CENTRAL ANGLES, FOR POLYGONS OF FROM 3 TO 25 SIDES

Forging-press Dies for Axes and Quarry Tools

By Pressman

The daily papers tell us that the timber is about exhausted in this country, but nevertheless our shop goes on getting out wood-chopper tools by the thousands. These include mauls, wedges and timber bars. The forging press keeps grinding them out in almost endless variety. In Fig. 1, *A*, *B*, *C* and *D* show wood-choppers' mauls that the forging press gets out in good shape. One set of dies will do for the four patterns, provided, of course, the average weight, 8 pounds, is the same. *A* and *B* are almost the same pattern, with the exception that *B* has the bit made about ½ inch wider; that is done by the operator shoving the blank farther through the dies to a stop gage. This gage is not required with *A* as the contour of the dies is just right for the purpose. Maul *C* requires a die *I* to break the edges by rounding the surface left by the smoothing dies *E*, giving them a slight taper. The bit on *C* is ½ inch wider than *D*, and is a straight taper from end to end, while *D* is straight; but the taper in the dies *E* is overcome by depressing the top and raising the bottom dies with a small wedge at the back. When used to make *D* the same means are used. On other taper dies, when just a slight

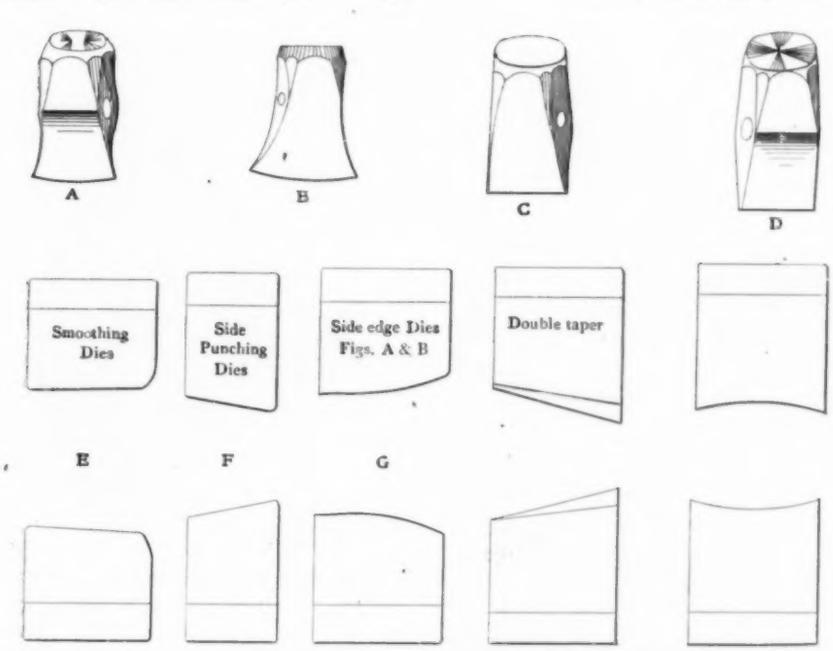


FIG. 1. DIES FOR WOODWORKERS' AXES AND MAULS

change is needed to accomplish a given purpose, it is well for the pressman to have on hand plenty of wedges of all kinds for this purpose, and to fasten his dies in the table. It is also well to have packing of all thicknesses for raising the dies, as often by putting a plate 1/16 inch or ⅛ inch thick, on top of the smoothing die, the same result is attained as by raising the die. This method is generally used in pointing crow, pinch and lining bars. It answers the purpose very well in changing from one size to another, and saves shimming or changing dies.

The forging of quarry tools is quite difficult by any other means than the forging press, but under the skilful manipulation of a good pressman the work is done quickly and is well finished and uniform.

Taking the mason hammers *A* and *B*, Fig. 2, and the stone-axes *C* and *D*, it can be readily seen by anyone familiar with this class of work that forging these under the drop or steam hammer would necessitate two to four heats and perhaps more. Under the press they are easily made in one heat, and where the dies are kept in good condition the finish is neat and smooth.

I select these four models because they are practically the same and one setting of dies answers for them all. The shears, punch, punch block, stripper, eye-pin and smoothing dies are the same as shown before. The beveling dies *E* are for the face, *F* is the punching die for the ax point, *G* the die for cutting the teeth, and *H* the stripper and guide for the punch. *I* shows two views of the punch. This die and punch have to accommodate themselves to several sizes of hammers, *B* and *D*, the stripper and guide, being made adjustable to shift up or down. To keep the stripper straight and rigid, square studs are used to fit snugly in the slot, as shown at *G*. Side gages must also be used; they are fastened to the stripper by ½-inch cap screws. The depth of the cut is gaged by the hight of the stripper, as the bevel of the hammer will only let it go as far as needed when the stripper is set the right hight.

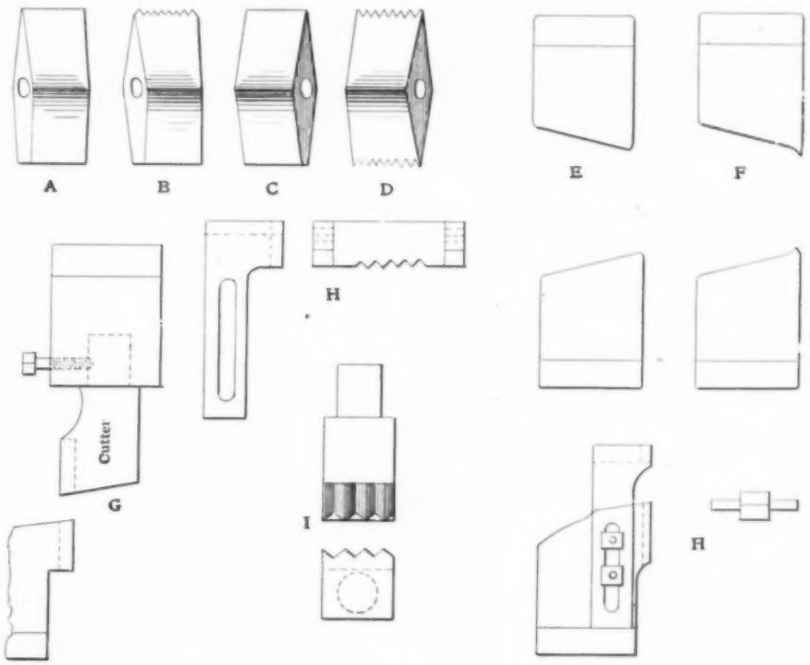


FIG. 2. STONEWORKERS' MAULS AND TOOLS FOR MAKING THEM

New Fire-resisting Material

Asbestos wood is the name of a new fire-resisting material to be used in place of wood in office buildings and similar places, to make them really fireproof. This utilizes short asbestos fibers which have heretofore been largely a waste material, and makes them of value in a new way. It is patented by Prof. Charles L. Norton, of the Massachusetts Institute of Technology, and will be put on the market shortly.

Welding Steel With a Blow Pipe

Made Possible by the Use of Oxygen and Acetylene, Which Produces the Hottest Flame Known and Can Cut Steel Six Inches Thick

EDITORIAL CORRESPONDENCE

The use of the blow pipe for soldering or brazing is common in every shop, but a blow pipe that will weld steel and many other metals is something out of the ordinary and makes it possible to use sheet steel for many purposes where forgings were heretofore necessary.

FIG. 1. SHOWING BLOW PIPE AT WORK

The Worcester Pressed Steel Company, Worcester, Mass., has recently installed an apparatus known as the "Autogenous" welding system, which uses a combination of oxygen and acetylene, under pressure, to produce a welding heat at any point desired. This plant is the second of its kind in this country, although a similar system is used by some manufacturers in France.

Hottest Flame Known

The oxy-acetylene flame, produced by this mixture, is the hottest known, having a temperature of 6300 degrees Fahrenheit, or 2700 degrees higher than the oxy-hydrogen flame. This, together with the facility of handling the blow pipe and the absolute control of the flame by the operator, gives this process an almost unlimited range of usefulness in metal industries.

One of the features which has made this commercially possible is the introduction of a substance known as "epurite." This, when brought into contact with water, gives off chemically pure oxygen in much the same way as the acetylene gas is obtained.

The blow-pipe is small and easily handled, as can be seen in Figs. 1 and 2. In Fig. 2 can be seen the gages, piping, etc. The men wear dark goggles to protect the eyes.

How the Gases Are Used

In this welding process each gas is generated in a separate apparatus conducted by separate pipes to the blow pipe, mixed near the point of combustion, and used in nearly equal volumes at a pressure of from 15 to 25 pounds. In starting the blow pipe, the acetylene is first turned on full; then the oxygen is added until the flame has only a single cone. An excess of acetylene produces two cones and a white color; an excess of oxygen is indicated by the flame assuming a violet tint. The point of intense heat in the flame is at the apex of the cone.

In welding this is held about ¼ inch from the metal to be welded. The hydrogen and carbonic oxide generated protect the molten metal and also the flame cone from loss of heat. No flux is required to weld metals such as iron, steel and copper; but for alloys, such as brass, bronze, etc., a little borax or boracic acid moistened with water, is used simply to prevent the volatilized zinc from being deposited on the joint and destroying the weld. This process welds by fusion, forming a perfect metallic union of the parts. It is not brazing in any sense of the word.

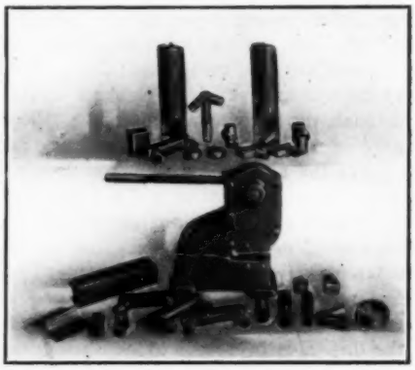


FIG. 3. EXAMPLES OF WELDING

FIG. 4. A DIFFICULT WELDING JOB

FIG. 2. OXY-ACETYLENE BLOW PIPES AT WORK

Replaces Riveting

The Worcester Pressed Steel Company employs it in place of riveting and

soldering and for other forms of metal construction not heretofore possible. Two sheets of metal may be welded by placing their edges together and following along the seam with a blow pipe. Tanks of almost any shape may be made by forming the body and end separately and, in assembling, tracing the seams (joints butt and flush) with a blow pipe.

The joint is so perfectly welded that, after finishing, it is impossible to detect where the joints were made. To insure strength the joint is slightly overloaded, by melting a wire or rod of the same material as the metal to be welded at the same time the edges are fused.

This makes the rough joint stronger than the body of the metal and the finished joint the same strength as the body itself.

welded by this process. This also shows various tanks and parts welded.

Fig. 4 shows an interesting job of ¾-inch steel that was successfully welded. The size is shown, and the chalk lines indicate the weld.

In the foundry, this apparatus saves defective castings in iron, steel, copper, brass, etc., for the blow holes can be readily filled and broken castings welded as strongly as new. In repair work it is especially valuable and many expensive castings, forgings and machined parts may be saved from the junk pile by an hour's use of this blow pipe.

Its Use in France

This same process is also being used in the new works of the Société Française de Constructions Mechaniques, at Denain,

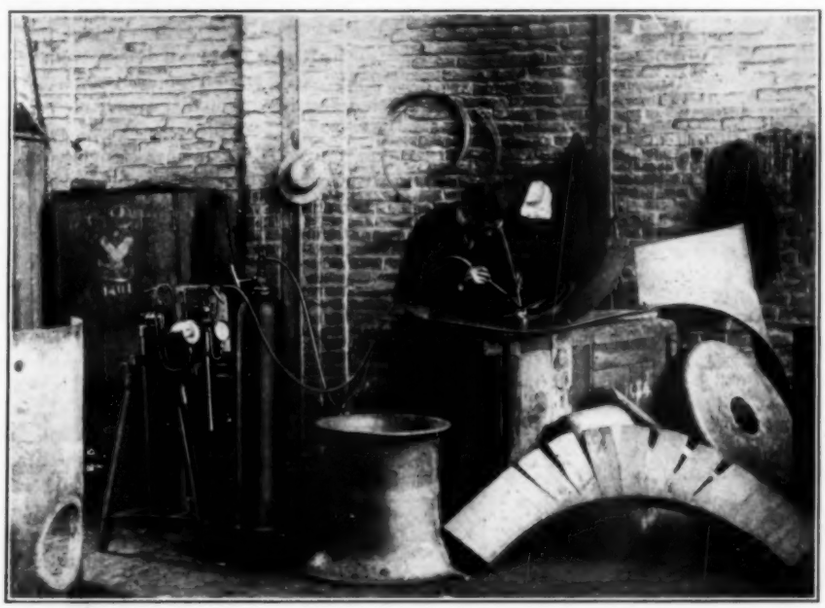


FIG. 5. THE WAY IT IS USED IN FRANCE

It is also used for cutting steel, as any shaped hole can be easily cut in steel plates up to 6 inches in thickness and, as with the blow pipe, the operator can accomplish cutting feats impossible with a saw.

Twenty different sized nozzles are supplied for each blow pipe. The size and power of the flame can be varied at will, according to the thickness of the metal to be welded. In cutting, the flame is proportionately elongated by pressure to penetrate to the bottom of the cut. The intense heat is so localized that the kerf is practically the same as if a saw were used.

Examples of Work Done

Not only is this process adapted for making tanks, boilers, tubing, cylinders, pipe joints and angles, and for replacing riveting and brazing in many instances, but it effectively welds cast iron.

An example of this is seen in Fig. 3, where a small shear has had the frame

especially in sheet-metal work such as casings for domes and similar work, as seen in Fig. 5. This shows quite a variety of work being handled and the use of the wire to overload the joint or make up for any undue wasting of the metals.

This process seems to present many advantages and open up a large field of possibilities in the joining of metals when the shape and material has heretofore made riveting necessary. In addition it is worth while to note carefully that it is not a joint made by an interposed metal, but is a true union by fusing of the metal of the pieces being joined. F. H. C.

The amount of scrap composition or bronze on the market, which does not contain lead, is comparatively very small, and it is impossible to obtain any regular quantity of it. The brass founder will have to use new metals when mixtures free from lead are to be made.—*Brass World.*

How I Became a Foreman

By Ethan Viall

The average toolmaker, if he is at all competent and understands his business thoroughly, is a living illustration of the old couplet:

"My grandfather was the most wonderful man that ever was seen;
He built everything from a needle clean down to a thrashing machine."

A toolmaker is expected to make a die, set spirals in the milling machine, forge a tool, braze a band saw or do anything that comes his way. He is not merely a specialist, as the name implies. A man may make jigs and dies all his life and yet not properly be called a toolmaker, as the term is understood in the machine shop.

He must not merely be a "jack of all trades," either, but he must be master of a dozen or more closely allied ones. It necessarily follows that nowhere in a machine shop is a good general education in addition to a thorough knowledge of machinery needed so much as in the tool room.

The Education Needed

Not even the drafting and designing rooms need education so much; yet how often do we find it most conspicuous by its absence, and how often is the most carefully planned jig rendered useless by the lack of a little more knowledge on the part of the toolmaker?

A man need not be a university graduate nor have spent several years "doing" Europe, nor even have taken a technical course, though the last is an immense help. But he can acquire a splendid education by carefully reading the best mechanical journals and books on various mechanical subjects, which may be obtained at almost any circulating library.

It is to the tool room that a firm usually first looks when in need of a shop foreman or a superintendent; but how often are they compelled to look elsewhere because no one there has shown general knowledge or ability enough for the place?

Reading Counts for Much

To the young man who wants to be a toolmaker, I would say:

"Get a high school education if you possibly can; but if you can't, then get as much as possible and then in addition to your shop work, read, read, read. Read the shop magazines, study the machine, and tool catalogs, and the advertisements of the big shops and factories. Whenever opportunity offers, visit other shops and always keep your eyes and ears open, but let others do most of the talking.

"Make friends with the 'old timers,' and learn their special hobbies in the mechan-

ical line. Get books on diemaking and jig work, and find out how other men go at a job.

LEARN FROM ANY SOURCE

"Don't get the idea that lots of toolmakers have, that nothing can be learned from the common machinist or even laborer, but watch their short-cuts on difficult jobs."

Lots of "old hands" can give the smartest toolmaker in existence pointers on certain jobs, and no one who is a man will be afraid to take suggestions from them.

One never knows when some little thing he has learned will help him over a hard place. How often has the short course in chemistry given in the high school helped me; and, too, how much the meager work I had in drawing and geometry helped when I was studying mechanical drawing at home evenings!

GETTING MY START

At one time, when I was learning my trade, the head of the firm brought some small copper articles to the tool room and wanted them finished in "antique." There was no one in the whole shop who happened to know how to do it; but I had read up on that subject a short time before and I quietly told the foreman that I thought I could do it. With his consent I got 5 cents worth of sulphide of potash, some hot water and an old polishing wheel, and did a job in "antique copper" finish that was the beginning of my advancement.

A FAILURE AND A SUCCESS

After that, whenever anything unusual came up I was given first whack at it, and as it luckily happened I failed only once. That was in trying to braze a piece of cast iron, but hundreds of others had failed on that. (I didn't know it then or I wouldn't have felt so bad). Though I failed I didn't give it up, but put in a good many odd hours trying it. Several years later I discovered one of the three known mixtures, not one of which was in existence at that time.

Once I was given a piece of aluminum to smooth up after another man had almost ruined it in his attempts to file it dead smooth. I put in practice a little kink I had been told about taking the edges off the file on a grindstone, and presto! I filed that piece of aluminum as smooth as glass.

After I had been three years in this shop I was made foreman in place of the former one, who had taken a place in another factory, and it never has been necessary for me to work at the bench since.

NO SPECIAL OPPORTUNITY

My chances were no better in the beginning than any other man's. Anyone of good mental capacity can do as well if he only will.

Many a good old workman is still at the bench because he would rather sit and smoke or play cards in the evening than see what is going on in other shops through the pages of some magazine.

Of course, some do get up a little way through sheer native ability; but where would they have been if they had used the opportunities that are every man's?

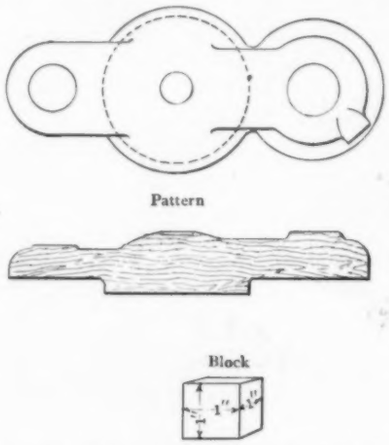
DON'T DEPEND ON "PULL"

The only "pull" a man needs is the one he weaves himself. A "pull" won't grow by pouring beer on it; but a smile and a readiness to undertake a disagreeable job, the art of being accommodating and a gentleman in the true sense of the word, will make it grow so fast that one will have to hustle to keep up with it.

A Method of Checking the Compression Space of a Hydro-carbon Engine

BY E. J. BARTLETT

Every designer of any form of hydro-carbon engine knows that it is a difficult problem to lay out the compression space



PATTERN FOR CHECKING COMPRESSION VOLUME IN A HYDRO-CARBON ENGINE

to conform exactly to a predetermined cubical capacity necessary to give the compression desired. This is due to the unsymmetrically shaped space, which is usually composed of numerous pockets and depressions, the volume of which is difficult to calculate accurately.

With the aid of the patternmaker a very simple and accurate check on the volume of the compression space may be made, which is perhaps new to some readers. After the space is calculated as accurately as possible and the detail drawing of the cylinder made, its dome and the portion of its bore which is not closed when the piston is at its extreme outward position are reproduced in a sketch from which a pattern is made. From the same material make a comparative block of some easy dimensions, such as one inch square. By comparing the weight of a block of which the cubical contents are known with that of the pattern it is easy to calculate the cubical contents of the latter and compare it with the capacity desired.

If any correction is found necessary, it can usually be made by raising or lowering the top of the piston. The sketch shows a pattern and block.

A Milling-machine Rig for Cutting Worms

BY JOHN P. WHEELER

I had quite a number of machinery-steel worms to make recently, about 3⅛ inches in diameter, both right and left hand. Cutting these in the lathe I found too slow, so I decided to try to mill them. I have a No. 2 universal miller, but no vertical attachment, and the firm would not buy one, as they are quite expensive. To rig up for the job I took a plain gray-iron block about 12x6x4 inches that I had in stock, bored a hole in it 3⅞ inches in diameter, to clamp it on the arm of the miller, and mounted on it a gear on a stud meshing with another gear held on the spindle nose. This in turn drove a short spindle carrying a 12-toothed steel spiral gear which drove a 30-toothed bronze spiral gear mounted on the rear end of another spindle running at right angles to the main spindle of the machine. This spindle was 1½ inches in diameter and fitted a hole carefully bored (not reamed) in the gray-iron block. No means of adjustment for wear was provided, except a collar to take up the end shake.

I found this rig exceedingly rigid, as the cutter was held very close to the bearing. It would carry a roughing cut full depth, and nearly ⅜-inch feed as fast as the machine would drive, without chattering. The worms took, on an average, from 1 to 1½ hours each to mill, an apprentice doing the feeding by hand and using two cutters, one for roughing and one for finishing.

I subsequently found this rig very convenient for cutting racks, sawing off stock, cutting cross slots in long work, etc. After several weeks' work I could detect no appreciable shake in the spindle, which ran perfectly cool. I used Albany grease on the spiral gears and they gave no trouble. One of the chief advantages of the rig I found to be in the ease with which it could be put on and taken off. It is just as quick as changing a cutter arbor.

Of course the table had to be set over to the angle of the worm. This angle was easily found by consulting a table of natural sines. The spacing of the threads was done by means of the index. The index handle was used for feeding, as it would have been too great a strain on the feed screw to feed in the usual manner. Of course I know many firms mill worms in this manner, using a vertical attachment; but I thought my experience with a cheap, home-made rig might be of interest.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

An Historical Engine without a Known History

The print shows our historical old shop engine made by our junior. From the report of John Welsh (who retired about six months ago) this engine was in service when he first went to work for Leeds & Co. in 1857, and he tells me there was never a drop of oil given the cylinder until they made a new piston for it some time in 1895 or 1896 and that the cylinder was as smooth as a looking-glass.

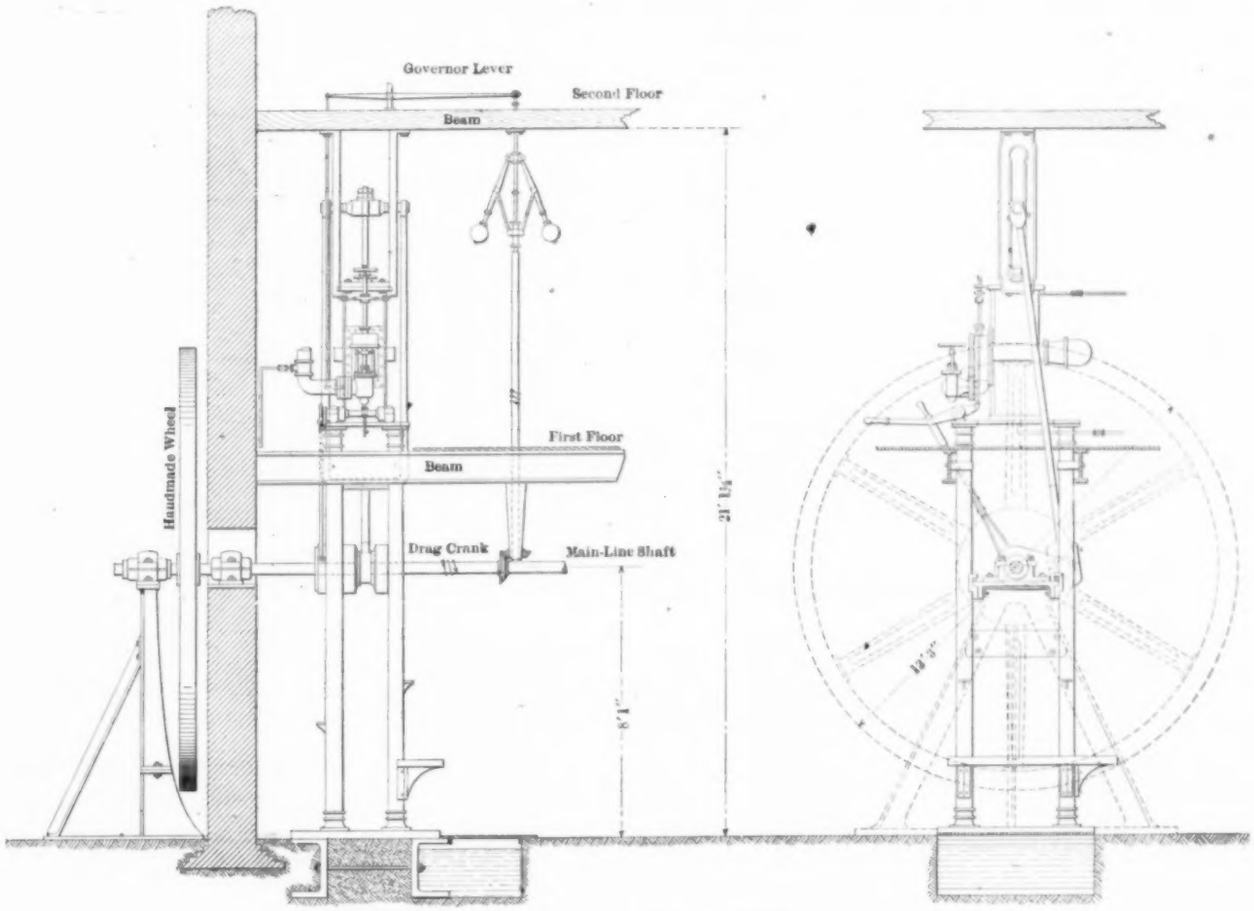
The engine is 15x36 inches and was running up to two years ago at 44 revolutions per minute and developing, at the time I indicated it, 15 horse-power. It was running so nicely and smoothly that nobody knew that there was an engine in the shop.

The main line of shaft is still in operation, as we have blocked up the fly-wheel crank and connecting-rod to clear the drag crank, which is keyed to the main line.

You will see that the governor is operated from the drag crank. The rise and fall of the governor balls operate the governor lever on the second floor, the short end of this lever being connected to a butterfly valve next to the throttle.

I intend to put this old engine in operation again for a couple of days so that I can change some line shafts and repair our present engine. I give these facts as I have them; we have lots of men who worked in this place 25 and 30 years ago, among others George Weiman, who has just celebrated his being 50 years a patternmaker. None of the these men ever knew of any other engine in the place. My reason for discarding it is that it is wasteful and costs too much to overhaul.

JAMES BECK.



AN OLD ENGINE WITHOUT A KNOWN HISTORY

More about Filing Clippings

To my notion, the main advantage of Perrigo's latest filing scheme is that it utilizes ready-made cabinets which can be started at any time you happen to have the price and enlarged whenever you are fortunate enough to be in a similar state of plenty.

But I don't like the scheme because it involves too much writing and takes too much time. No plan that requires a card being made out for each clipping appeals to my sense of fitness for busy men—perhaps lazy might fit my case better.

I still cling to the antiquated and despised envelop system, and while I probably do not use it any more intelligently than anyone else, I cannot see why it needs to have the disadvantages he claims.

You can have envelops enough to sub-

divide your clippings to any extent desired, and there is no excuse for crowding one class any more than with the card index, the clipped columns and other details he described.

My envelops are 6½x9½ inches, opening on the long side. They can have flaps or not just as you prefer. The class or contents are noted on the upper left-hand corner so as to be readily seen as:

Threads—U. S. S. Boilers—Locomotive

and in the same way other threads or subjects can be classified.

I use guide cards between the envelops to divide them into classes. These can be arranged so as to facilitate finding the envelop you want in as little time as you find your index card, and you save all the time of looking up the clipping itself.

I file all data, whether clippings, notes taken from text or other books, or anything else in the envelops. If any cross references are necessary, put them in the envelop too. I do not believe it is a good plan to have more than one place to look for any clipping.

No cards have to be filled out except for a cross reference to a clipping which may be part and parcel of something else. The clipping is simply filed, folded if need be, in its proper envelop, where it can always be found and where there is no more need of its being crowded than there is of filing too many clippings in a compartment or making two entries on one index card.

I made my cabinet before the days of vertical filing of letters, and if I were doing it over again I should be tempted to use a stock of these, as they would require only a little trimming for 9x12-inch pages, such as the AMERICAN MACHINIST, and this has some advantages.

So I'll stick to the envelops, thank you, and those who like to make out index cards by the dozen will follow the Perrigo plan.

One great difficulty with all of us, not of any of the systems, is that we allow too much dead matter to accumulate.

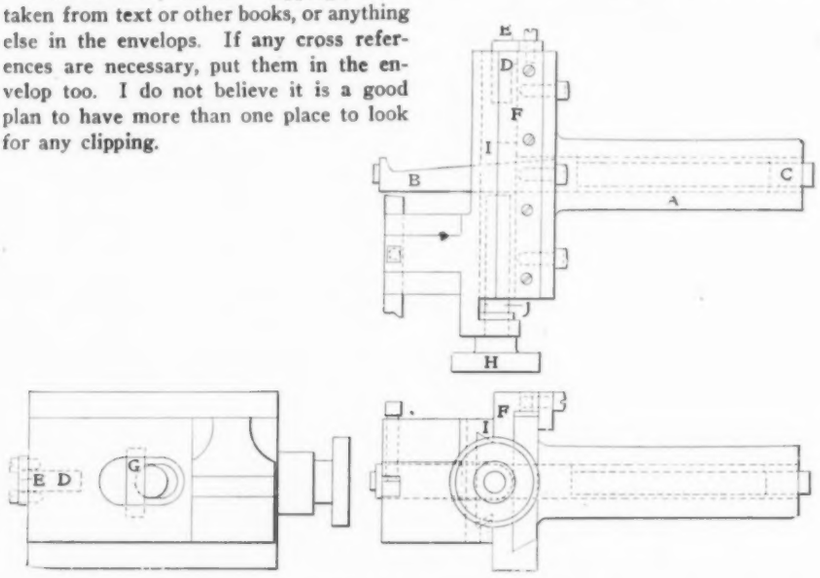
R. E. MARKS.

Taper-turning Tool for Screw Machine

The sketch shows a tool we designed for finishing taper plugs, varying from 1½ to 3 inches, 1¼ inches long, taper 1½ inches in 12 inches. The shank *A* is turned to fit the turret and has a hole bored through the center to accommodate the rod *B*, which is flattened on one side to the required taper, as shown, the taper on the rod being one-half of that required on the work. The main part of the rod is turned to fit the hole in the shank, the rear part of the rod being reduced to provide room for a coil spring which is just strong enough to return the rod to the position shown in the sketch. The bushing *C* supports the rear end of the rod and takes the thrust of the spring. The taper slide is held against the rod by the back pressure of the tool against the work, but in order that there shall be no lost motion a strong spring is provided at *D*. The plate *E*, which is fastened to the shank *A*, takes the thrust of the spring which is set in the hole drilled in the taper slide *F*. Thus the hardened-steel plate *G* is always held up firmly against the rod *B*. This plate is fastened in the taper slide by two machine screws. The hole in taper slide *F* is slotted out sufficiently to allow the rod to be removed and another substituted when a different taper is desired. The sketch shows the location of the gibs.

The adjustment for size is obtained by hand wheel *H*, which moves the adjusting slide *I* by means of the screw *J*, which fits the nut in the taper slide. The sketch shows the tool, which is a piece of square steel, and the means of holding it. The end view merely shows the position of the plate *G* which bears against the taper rod and the manner in which the taper slide and adjusting slide *I* must be slotted out to allow necessary travel. In use the rod *B* bears against the end of the work and remains stationary as the tool advances. When necessary to take two cuts a stop (not shown) is provided for the adjusting slide, so that the tool may be brought up to the stop for the finishing cut.

W. T. H.



TAPER-TURNING TOOL FOR SCREW MACHINE

Machining Chain Links

Some time ago there was a large number of chain links to be machined. The style of the link is shown in Fig. 1. Some were of cast steel and some drop-forged, each link being machined to gage and interchangeable. The two projections on each link were bored, turned on outside, and faced top and bottom.

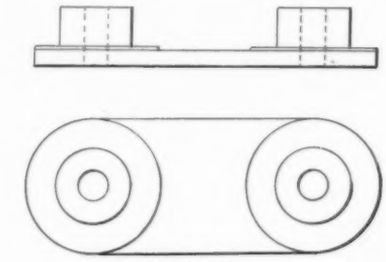


FIG. 1

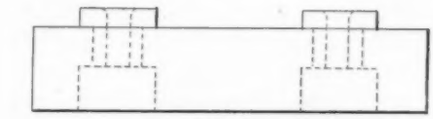


FIG. 2

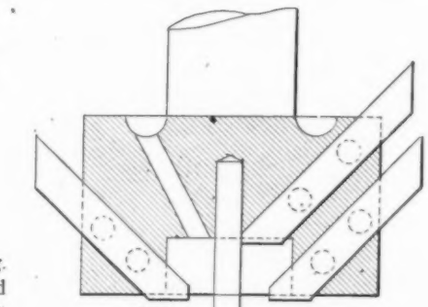


FIG. 3

TOOLS FOR MACHINING CHAIN LINKS

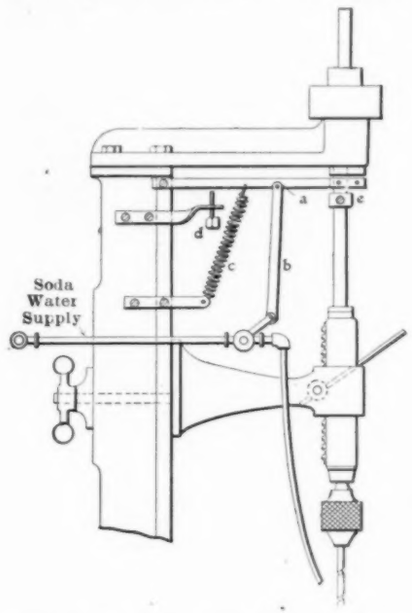
Drilling was the first operation, the jig shown in Fig. 2 being used. For turning and facing we used the hollow mill, shown in Fig. 3. The body of this mill was of machinery steel, the three cutters being of high-speed steel. The two lower cutters turned the outside of the projections, one cut only being taken, and faced the surface at the bottom. The upper cutter at the same time faced the top of the projection.

A deep groove was turned on the top of the cutter, as shown in Fig. 3, and three holes drilled from the bottom of this groove into the recess for the cutters. An ample supply of water was led into the

groove, and, passing down to the recess, cooled the cutters and washed away all chips. The body of the cutter was also cut away to allow the cuttings to escape freely. W. BURNS.

Automatic Water Valve for Multiple-spindle Drills

In multiple-spindle drilling, where the use of soda water or other lubricant is required for the cutting tools, it is customary to convey the lubricant from a central source of supply, distributing to the several spindles by means of suitable piping. The flow at the spindle in use is regulated by means of a stop cock or valve, which must be opened by the operator at the beginning of the cut, and closed again at the finish. This requires



AUTOMATIC WATER VALVE FOR MULTIPLE-SPINDLE DRILLS

an appreciable amount of time, and when multiplied by the use of several spindles often amounts to quite a percentage of the time required for performing the entire operation.

The sketch shows the method adopted by the writer some years since for avoiding this loss by causing the regulating valve to open or close automatically with the upward or downward movement of the drill spindle, entirely independent of the operator.

In the sketch, *a* is an arm, one end of which is pivoted to the drill-press column, the other end carrying an eye with a hole sufficiently larger than the drill spindle, to allow the arm free play up and down after the spindle is passed through the eye. In this instance the eye was made of sheet steel and riveted to the end of the arm, the hole being made about ⅛ inch larger than the drill spindle.

This lever was connected to the handle of the valve by the link *b*, causing the valve to open and close with the upward and downward movement of the lever *a;* which was held at its lowest position against the stop screw *d*, by means of the coil spring *c*, in which position the valve is open. Upon the drill spindle is placed the collar *e*, held in position by a set screw.

In operation, the valve is fitted to move freely, a slight leakage being of no consequence, the collar *e* being adjusted to hold the end of the arm *a* up against the upper bearing of the drill spindle when the spindle is in its highest position, when the valve is closed. The spring *c* is adjusted with sufficient tension to freely work the valve when the end of the arm *a* is released by the downward movement of the drill spindle and collar *e*. The tension of the counterbalance spring of the drill spindle should be sufficient to return the spindle to its highest position when the feed lever is released, thus holding the valve closed while the spindle is running idle.

This sketch is drawn from memory after an elapse of ten years or more, and the orignal rig was made under conditions which made it necessary to not only draw the materials from the scrap heap, but also to keep its construction more or less of a secret.

It is possible, however, that it might have been better designed had it passed through the hands of an expert and the work done under different conditions. Although its construction was somewhat crude, it proved itself a great success, and was continued in use on bicycle work for several seasons with excellent satisfaction.

In this instance the lubricant used was soda water fed by gravity from an overhead tank and distributed by means of a main and suitable branch piping to the several drill spindles, the drainage being collected and returned again to the overhead tank by a suitable pump.

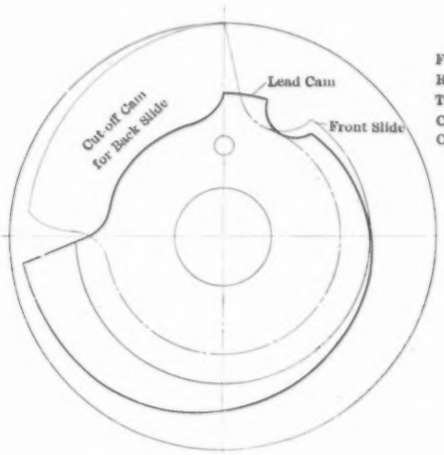
H. D. PENNEY.

Box Tools for Small Taper Pins and Handles

Being interested in the working of automatic screw machines, and the Brown & Sharpe in particular, I read carefully the article at page 402. I think the box tool shown is a good one, but for Tapers to say that no tool could be found on the market to make a good taper pin is at least absurd. The makers of the machine supply one with this distinct advantage that the stays engage on the work immediately behind the tool, thus insuring a nice, smooth finish and work to fine limits. This tool is just as easily set and works as accurately as the ordinary box tool for straight pins.

I must say that the description given of the working of the cams is a little weird. Tapers says that after the pin is formed the tool backs off, and the rear tool post advances with the cut-off tool; later on, that the cam shown at Fig. 15 is for operating the rear tool post. I cannot see how that cam can advance a cut-off tool, as there is not the least sign of a rise on its whole working portion. Then, again, he says that Fig. 13 (which is obviously the cam for cutting off) is for feeding stock. Now in these machines the stock-feed device is operated by a small dog which can be adjusted to any point round a disk placed at the front of the machine, and special cams are never used to feed stock. I take this opportunity of mentioning that many operators are prevented from following the advice of the makers of these machines because the book issued specially for their use is jealously guarded in the office. Hence some of the peculiar specimens of cams seen in various shops.

Gorton, England. M. E. CHANIC.



	Revolutions	Hundredths
Feed Stock to Stop	20	5
Revolve Turret	24	6
Turn ¾ at .003 per Rev.	250	62
Clearance	16	4
Cut-off and Round End ⅞ at .002 per Rev.	90	23
	400	100

Spindle Speed 2400 R. P. M.
Gears 40-40
Gross Product 3600

CAMS AND DATA FOR TAPER-PIN TURNING

I have read the article at page 402, by Tapers, in which he says there is not a tool on the market which will turn out taper pins with any accuracy. I should

like to have him try the Brown & Sharpe taper-turning tool on his No. 00 machines, a tool with which I have made some thousands of taper pins ¾ inch long by ¼ inch at the largest end, with 0.008 of taper, which had to pass a gage with a 0.001 limit for either end, and the sides were not convex nor variable in size.

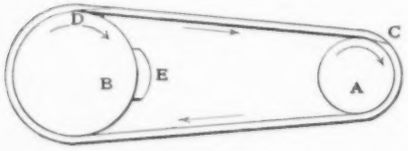
The cam details he gives are wrong. Considering Fig. 13, which is marked "Feed Stock," if that is the lobe of the cam for feeding stock to, it should not have a rise on it, for should he feed the stock to, say, half-way up the rise, his slide has still 1/16 inch to travel which means it would push the rod in, or, if the chuck was very tight, it would throw his spindle belt off every time. And if he feeds out to the top of the rise, what use is the 15 hundredths of cam surface that is taken up by that lobe of the cam? The cam he shows at Fig. 15 is for cutting off; yet it has no rise at all and takes up 71 hundredths cam surface, which, together with cam Fig. 13 and clearance, takes up 92 hundredths cam surface, leaving only 8 hundredths to turn ¾ inch of taper. The accompanying sketch shows a set of cams with correct data for making taper pins on an 00 Brown & Sharpe automatic, using a Brown & Sharpe taper-turning tool. AUTO OPERATOR.

Beeston, England.

Which Way Should Splices Run?

I have noticed quite excitable discussions as to the proper way to apply a spliced leather belt to pulleys to prevent ends of splices from rolling, caused by friction on the faces of pulleys.

Calling *A* the driving pulley and *B* the resisting pulley, *C* and *D* are splices in the belts, pulleys running in the direction of the arrows. *E* is a brake shoe representing resistance. Suppose the brake is strong and causes a good deal of slipping in the belt, what will be the effect on the



WHICH WAY SHOULD BELT SPLICE RUN?

splices if cement is not of high grade? I would like to have opinions of others.

H. M. WOLF.

[It is evident that the same splice cannot be good for both pulleys. Consequently a compromise must be made, as is often the case in mechanics. The usual practice is to run the splices so as to be best for the smallest pulley, as this bends the belt more and increases the strain on the joint. In the case shown it would be best to have the splices run the other way. —ED.]

Two Drill-press Kinks

Most machinists who have taken charge of plants for productive purposes have found themselves up against a proposition like this: "Yes, we could do that job on

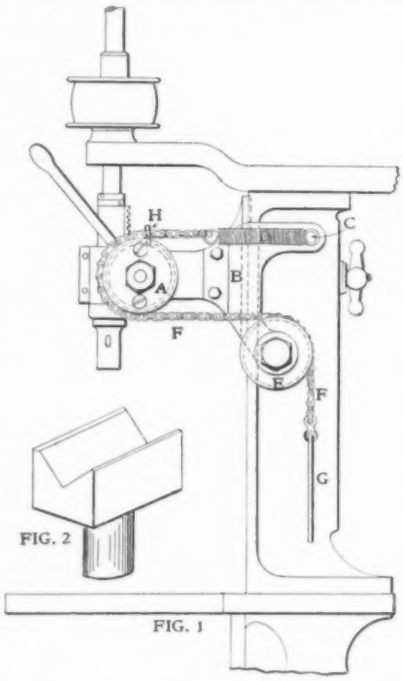


FIG. 2

FIG. 1

FOOT FEED FOR DRILL PRESS AND V CENTER BLOCK

this machine only for such a contrivance," or the tools for that job were made for such and such a machine which is now, and is likely to be, full up of work. Things of this kind sometimes make a man worry. Some men take down a back number of the AMERICAN MACHINIST, and sometimes something is found to fill the bill; at other times nothing just like it has come out, and the man has to think for himself.

We had a job to do which was originally done on a certain machine which was now overcrowded with work. Some other way had to be found, as hand work could not be thought of.

The sketches herewith show the way which was tried, and which was in every way a success. Only that part of the job is shown which is likely to prove of general interest. The job in question could be done on the sensitive drill if we could devise some way to bring down the tool to the work, and so leave the operator the full use of both hands to manipulate the work.

This meant some sort of pedal arrangement. Fig. 1 shows the general arrangement which was got out and is shown in position.

A gray-iron disk *A* was taken and bored out to fit on the handle part of the machine. It was fixed by two screws as shown, had a groove in its periphery and four slots were made to miss the lever.

A gray-iron bracket *B* was fixed to the machine by two cap screws as shown. This was furnished with a pin *C*, on which to fix the spring *D*. At its lower extremity it was fitted with a grooved pulley *E*. An old piece of cycle chain *F* was fitted as shown. A wire rod *G* was attached to the chain and taken down to a pedal on the floor; this, however, is not shown, but consisted of a piece of wood with a hook in its center, and hinged to the floor at its back end. A peg *H* was driven in disk *A* to make a positive drive. When not in use the chain was simply taken off disk *A*, leaving the machine free for its ordinary work. This could be moved up and down the drill column with the head and used at any point by varying the length of rod *G*.

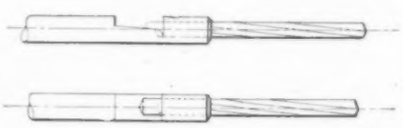
Fig. 2 shows a sketch of a block with a stem. Most makers of sensitive drills fit them with a cup with a stem to fit in a table bracket for drilling the center holes for lathe purposes. The stem of the V-block shown fits in the same place and has proved very useful.

If the manufacturers of drills were to fit them with this device it would be appreciated by most machinists, as it would be a welcome addition to the outfit of any tool shop. PRESSTOO.

Quick Way to Make an Extension Drill

Reading the article at page 541, by Louis Cerveny, on a quick way to make an extension drill without solder, screw, or cross pin prompted me to make this sketch of a quick and handy drill extension which is simplicity itself, and does not injure the drill for ordinary use.

The extension is simply a piece of ordinary drill rod, drilled out centrally in the bushing lathe with the drill to be

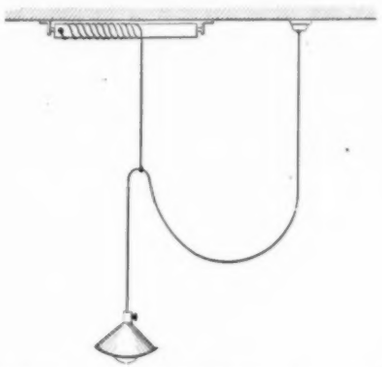


QUICK WAY TO MAKE AN EXTENSION DRILL

lengthened. A crosswise slot is either milled or filed down to the center at a slight angle with the center line of the extension. The drill is then filed off flat for a short distance at the shank, to fit the bottom of the slot in the extension, and then pressed home. The drill will then run true with the extension, and the short flat spot on the end of the drill gives a positive drive. NEW COMER.

Hanging an Incandescent Lamp over a Machine or Vise

I find that there is no handier way of hanging an incandescent lamp, either for use on a machine or vise, than the one shown in the accompanying sketch. Simply take the stick of an old spring window blind, cut it to a suitable length and attach it to the ceiling or any place directly above the place where the lamp is to be used. Attach to it a stout cord as shown in the sketch. Tie this cord to the lamp cord, and you have your light just where you want it when in use, and out of the way when not in use. No doubt this is a new kink to most machinists.

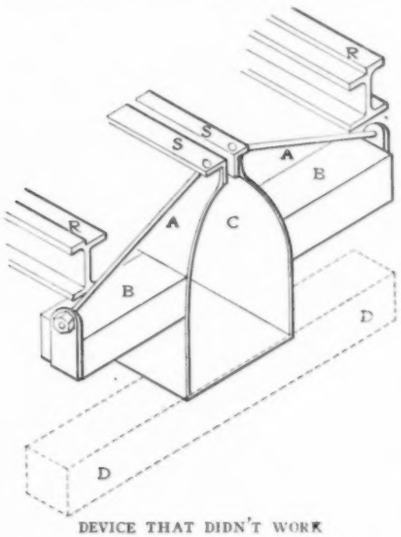


HANGING AN INCANDESCENT LAMP OVER MACHINE OR VISE

ROY GROVE.

A Device That Did Not Work

Mr. Ashley's description of the tool that failed to work, at page 322, reminds me of another scheme that didn't work and that cost the Philadelphia Traction Company thousands of dollars. As it shows how men who ought to know better fall into mechanical error, it may serve as an example of what not to do.



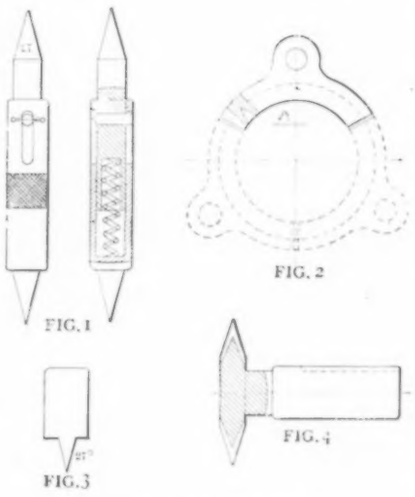
DEVICE THAT DIDN'T WORK

It was in the days of the cable road on Market street and the slot had a way of closing and gripping the grip to the discomfort of the passengers. So a bright genius started to equip the entire road with the slot puller shown in the illustration. Blocks *B B* butted against the conduit *C* and the rods *A A* were supposed to keep the slot plates *S S* from closing together. Any mechanic with half an eye can see that it was just a case of "lifting yourself over the fence by your boot straps." And yet several miles of this was laid. If timbers had been put in at *D D* so as to get a pull independent of the sides of the conduit. the plan would have been all right.

FRANK C. HUDSON.

A Gage for Brake Rings

The internal gage shown by Fig. 1 was designed to be used in machining the groove in brake rings. It is simple in construction and needs no description. The parts are of steel with hardened and ground working points. The zero mark was determined by fitting this gage into the gage for the brake wheel. The brake ring is shown by Fig. 2 and is cut into three brake sections.



A GAGE FOR BRAKE RINGS

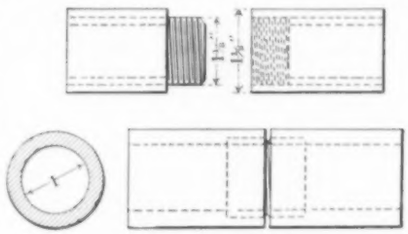
The former method of machining was to clamp the ring to the face plate of the lathe, turn the sides, bore the hole to size and then bore the groove to a gage, as shown in Fig. 3. The grooves were often cut too deep, so that the brake would bear at *A*, Fig. 2. This is of course less effective than if the bearing is for the entire length.

The present method is to turn the sides and bore the hole in the lathe. The groove is then milled on a circular milling attachment to the gage, Fig. 1. The cutter is shown by Fig. 4. The work is produced in this manner both cheaply and accurately.

W. Y.

A Spacing Collar for Straddle Mills

In my experience I have had considerable trouble with setting up straddle milling jobs. In a good many shops a spacing collar under 1/64-inch is as scarce as a five-dollar bill. Thin paper is used instead and a good many times it takes as long to set up a job as it does to do it.



A SPACING COLLAR FOR STRADDLE MILLS

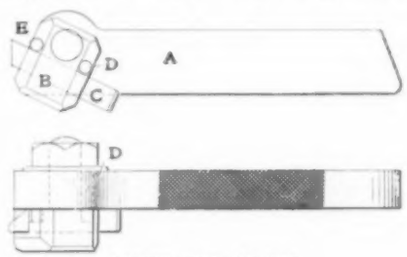
The collar shown can be expanded ½ inch; this can be done on the arbor, avoiding the time lost in taking it off.

If you use the small collars the arm brace must be loosened up and taken down, and a whole lot of valuable time is lost where here it can be done by loosening the nut on the arbor. If the threads are cut 20 to the inch for a half inch it can be opened ¼ inch and the pressure will not strip the threads.

F. SCHELL.

Tool Holder for Right- or Left-hand Tools

The accompanying drawing shows a tool holder which I made for an English style lathe slide-rest in which the distance between the slide-rest top and the lathe center was only ½ inch. The common type of tool holder, carrying ¼-inch square cutters with a constant top rake angle, of course could not be used with such a rest. The holder can be used either right or left handed. It consists of a machine-steel forging *A* having a 5/16-inch and a 3/16-inch reamed hole in the larger end. Fitting through the 5/16-inch hole is the shank of the tool clamp *B*, which is so shaped as to admit a ¼-inch square cutter *C*. The position of the cutter was laid out to bring it to the required hight and angle. I then drilled and reamed the 5/16-inch hole close to the top side of the cutter. After making the



LATHE TOOL HOLDER

clamp with a good fitting shank threaded on the end for a nut, I drilled and reamed the 3/16-inch hole to break into the corner of the clamp above the tool slot, as shown at *D*. I then fitted the clamp to the other side in a corresponding position and drilled into the corner of the clamp at *E*, using the hole previously drilled as a guide. The corners at *D* and *E* were cut away for easy setting. A hardened-steel pin fits the hole *D*. This is long enough to project ⅛ inch on one side and be flush on the other. This pin locates the clamp to give a constant top rake to the cutter and also to take the thrust of the cutter and prevent loosening of the clamping nut. To reverse from left to right, the nut and washer are taken off and the clamp changed to the other side of the holder, the nut and washer forcing the pin through into the corner *E*.

W. MADDISON.

L——, England.

Finishing Automobile Cylinders

In spite of all claims of boring automobile cylinders complete at one setting on the machine, I do not believe it is good practice. Whether they are to be finished by grinding or by a second passage of the boring tool, I believe the castings should be given time to relieve the initial strains as well as the changes set up by removing the inner skin of the casting.

And I am naturally pleased to learn that some builders of automobiles are even going further than this. After being rough bored they are placed in an oven or furnace and held at approximately the heat at which they run when in use, for a number of hours.

They are then given the finishing cut in the boring mill, and while this may be an unnecessary refinement, it certainly seems as if the cylinders should keep their shape better in actual service. If they do, it means less leakage and more power, which is the greatly desired feature of automobile engines.

I. B. RICH.

An Indexing Milling Fixture and a Turret Tool

Fig. 1 shows a milling rig, which may be used in connection with the spring chuck of the turret lathe for holding the work to be milled, and which is a very useful tool to have about the shop. It is simple and cheap to make. The sketch shows a plan and a half section. *A*, *B* and *C* are gray-iron castings. The extension on *A* has a channel for the lock bolt *D* to slide in. This bolt is forced forward by a spring, as shown. *E* is a mild-steel plug keyed firmly to the dividing plate *B* and secured with lock nuts which are adjusted so that the plug is free to revolve.

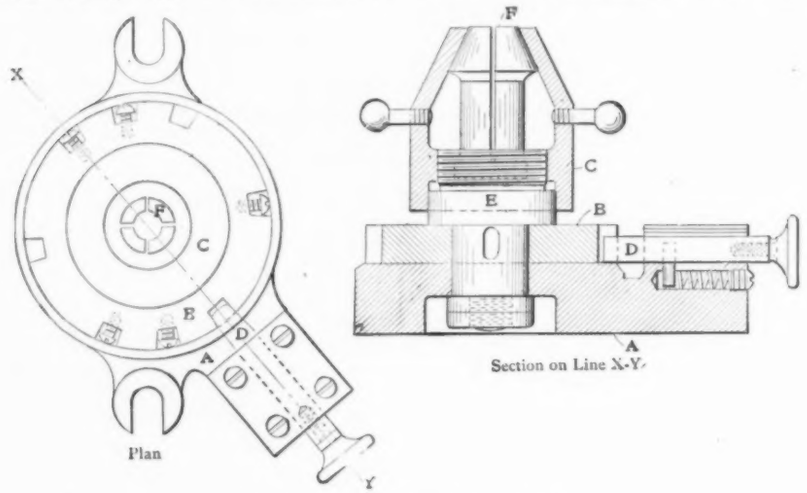


FIG. 1. INDEXING MILLING FIXTURE

E is threaded for the cap *C*, and bored for the back end of the spring chuck *F*, the enlarged portion of *E* also nicely fitting the hole in the cap so that the whole may revolve concentrically.

The dividing plate *B* is notched for milling 2, 3, 4, 6, 8 and 12 sides on the work. It is shown set for hexagon work which is to be machined with a pair of cutters. The screws in plate *B* are put into the slots not in use, thus making the device fool-proof.

Fig. 2 shows a method of turning the gun-metal casting *G*, the form of which is clearly shown in the sketch. The special tool box *H* is shown in plan, front and end elevations. It is of gray iron with a boss to receive the mild-steel shank, and a slotted ledge at the front for the tool-holder *I* to slide in. The tool proper is secured in its holder by a headless screw. The cap and the tool-steel pin *J* complete the tool box, which is held in one of the holes in the turret.

The cam plate *K* is gray iron, ¾ inch thick, with a slot cut to correspond to the shape of *G* when finished. I might add here that, before the cam slot is finally broken through at the end where the pin *J* enters, a wrought-iron plate is fastened to the under side of the plate, so that it will not spring and change its original shape. The plate *K* is fastened to the cross slide of the turret lathe, and packed up sufficiently so that the under side of the tool box *H* will just slide over it.

By referring to the sketch of the mandrel *L* it will be seen to be made in two parts, *M* being a separate plug screwed into *L*. The outside of the former is threaded to fit the casting *G*. Mandrel *L* is securely fitted to a false nose on the spindle.

The operation is as follows: Piece *G*, having been bored inside and reamed and threaded in a previous operation in the turret lathe, is screwed on to the mandrel *L*. The turret is pushed forward till the pin *J* enters the slot in plate *K*, then the cut is put on by the cross slide till the outer end of *G* is to gage. The taper cut is started by feeding the tool in again by the cross slide until the latter comes against the stop and the tool is then fed

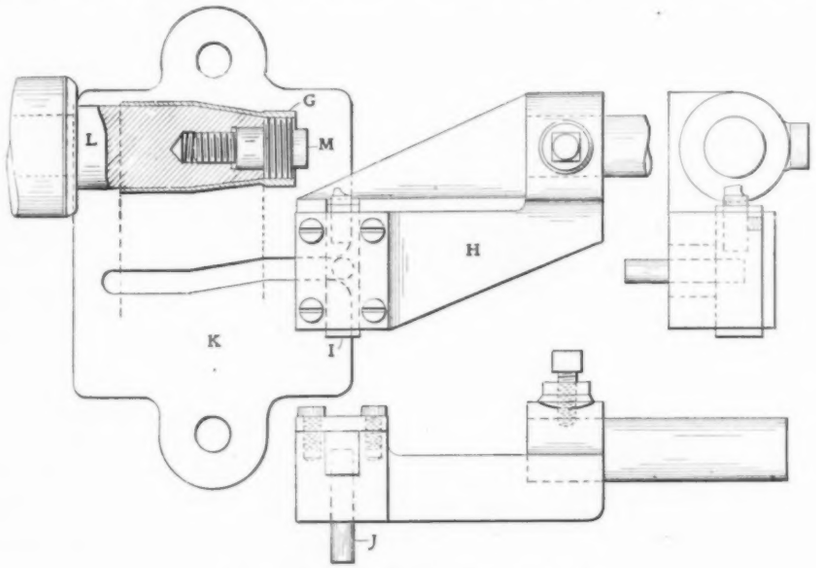


FIG. 2. THE TURRET TOOL AND THE WORK

along by the turret. After it is finished, the work is released from *L* by unscrewing the plug *M* a short distance, care being taken that the plug is screwed home again before putting another piece on.

We had a large number of these pieces to handle and the device saved a good deal of time and expense. The hole in the tool box *H* where the pin *J* comes through, is elongated sufficiently to allow plenty of movement of the tool when setting up. W. REYNOLDS.

Birmingham, Eng.

A Milling Fixture

The fixture illustrated in Figs. 1 and 2 has an excellent centering device. The piece to be machined is shown in Fig. 4, and is a casting requiring the two faces *A A* to be machined accurately to the width given and equidistant from the center. The two faces *B B* are finished parallel with one another in a previous operation.

The fixture consists of a cast-iron base *C*, with a hardened-steel plate *D* secured and doweled to it. A sliding V-shaped plunger *E*, also hardened, and actuated by a coiled spring at *F*, centers and at the same time holds the work against the locating points at *G G*. A hardened washer *H*, slotted to permit its being drawn off the stud *J*, serves as a clamp, and is tightened by the nut *K*. We found this a very satisfactory and simple fixture, and no doubt there are many cases where such a centering contrivance can be used.

Looking at some of the sketches sent by your correspondents, I notice there is a strong tendency to use nurled-head screws for clamping purposes. These are unsatisfactory in practice, as the nurl wears the finger ends. A much better plan, and one that can be adopted in the majority of cases, is to drive a pin of a suitable length through the head, a better hold and less injury to the fingers resulting. DRAFTSMAN.

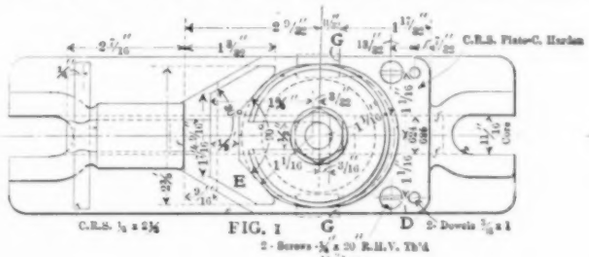


FIG. 1

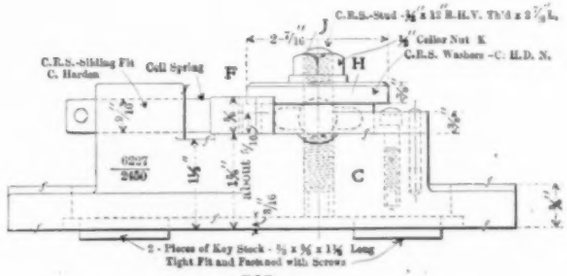

C.R.S.-Stud - ½ x 12 R.H.V. Th'd x 2 7/16 L.
½" Collar Nut K
C.R.S. Washers - C. H.D. N.
C.R.S.-sliding Fit C. Harden
Coil Spring
2 - Pieces of Key Stock - ⅝ x ⅜ x 1⅛ Long Tight Fit and Fastened with Screws

FIG. 2

THE MILLING JIG

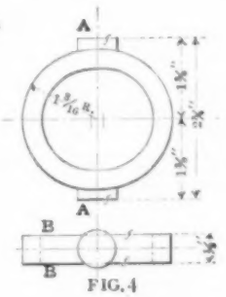
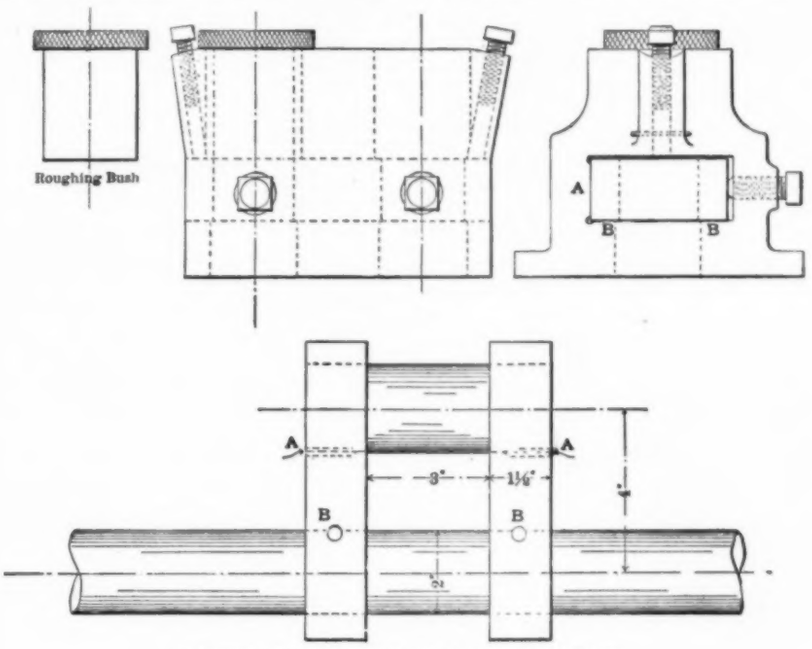


FIG. 4

Engine Cranks Built Up Without Turning

The writer some years ago had a number of small cranks to make for long-stroke steam launch engines, and as these were running at a slow speed, a somewhat novel idea was tried with considerable success; seeing that *no turning whatever* was done, a remarkably true and satisfactory job was turned out.



ENGINE CRANKS BUILT UP WITHOUT TURNING

The procedure was as follows: Flat steel, 3x1½ inches in section, was planed all over, and cut to correct length for the cheeks. Care was taken to keep two edges square, as these were made to register in drilling jig, Fig. 1, which is a strong gray-iron box open at both ends, machined on the bottom and two inside faces, *A* and *B*, at right angles. It is bored to receive a set of drilling and reaming bushes, and is provided with two sets of holding screws at top and side, as shown.

The crank cheeks were inserted one at a time (this was found to make a truer job) with their "*true*" edges bedding against the side and bottom, drilled and reamed to 2 inches, less 0.005 diameter through both holes for shaft and pin.

On removing them a letter was stamped on the edge bedding on the jig register marked *B*, to insure this face again being used to register when shrinking together.

Bright, 2-inch stock was next selected, which was found to be within 0.0015 inch of round and true. One piece was cut off to length of crank-pin, and one piece to total length of shaft over all.

SHRINKING CHEEKS ON THE SHAFT

After removing all burs, the crank cheeks were mounted on the shrinking plate, a gray-iron plate 2 inches thick, with a number of slot holes cast through to receive holding-down bolts. Both cheeks were placed the correct distance apart, and lightly clipped down; the whole was brought over an open fire on the brazing hearth, and the blow-pipe turned into the cheeks and plate until a dull cherry heat. The crank-pin was then slipped through flush, and as quickly as possible the crank-shaft inserted right through both cheeks to the correct distance and the holding clips released. The shaft end of cheeks was sprayed to induce this end to grip first, when the crank resembled Fig. 2.

Holes were next drilled to receive the

keys in *A* and *A'*, also at *B* and *B'*. The shaft keys were put in at right angles, as shown, to facilitate drilling, but if preferred, could have been put in with the ratchet. These keys were also shrunk in place, the crank-shaft again being heated for this purpose, and keys lightly driven home.

The next operation was to remove the center-piece between the cheeks. This was done under the cold saw and the whole polished up and tested for truth.

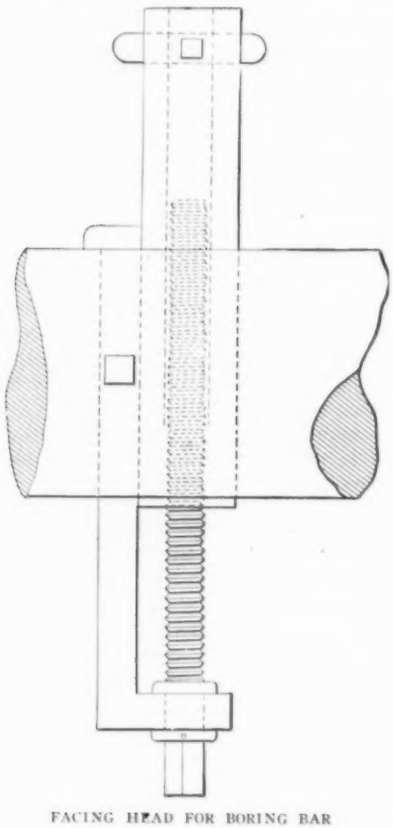
The objection to this type of crank is, of course, the absence of any radius or fillets at the corners, but this was met in the case in point, by allowing a very high factor of safety, with the happy result that no defect whatever showed after being put to work.

These cranks, when tested, showed that unturned cranks *can* be produced; the shaft in this case did not vary more than 0.002 out of line—quite as good as a great many turned cranks would be found.

Q.

Facing Head for Boring Bars

This sketch shows a very useful and cheaply constructed facing head for use on the horizontal boring machine, especially



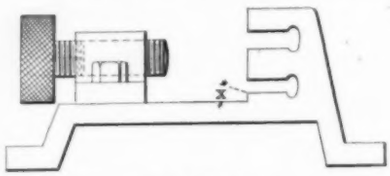
FACING HEAD FOR BORING BAR

where the work to be faced is some distance from the head of the machine. The facing heads usually made for horizontal boring machines are a little heavier than one man can handle easily and often too large to be used where needed the most.

VANDUZEN.

A Drill Jig for Knuckle Joints

On page 497 I note a comment of "Gutta Gitta" on a knuckle-joint drill jig. It appears just to me to question his authority for designating that design "American practice." The article describing the English jig is not at hand and it is perhaps a



A DRILL JIG FOR KNUCKLE JOINTS

risky thing to be too critical, for there may be conditions which justify "Gutta Gitta's" design; but they are hard to imagine. If it is "American practice," then the jig experts of my acquaintance are all Philistines.

Stress is laid on the fact that there are only four components, but your correspondent overlooks the fact that the number of pieces does not measure either ease of making or facility of use. The jig itself is a difficult piece to machine, and when made is a "slow handler;" hard to locate the piece to be machined and hard to keep clean. If the machining is to be accurate, the drilling seats must be *brushed* clean; shaking out the chips will not suffice. There is no provision for clearing the chips as the drill cuts. This is usually provided for by leaving a slight clearance under the jig bushings.

Assuming the pieces to be of medium size, with the pin hole from ¼ inch up to ¾ inch, and that they are to be made in a large quantity and with accuracy, a box jig drilling both pin and rod holes at once, or its equivalent, would be preferable. I should drill both holes and then mill out the fork.

If comparatively few pieces were to be made, a milling-machine vise with stops and a bushing for guiding the drill would be more easily handled than your correspondent's jig; indeed, this way would be easier for any number of pieces. For the rod hole an angle iron with a pin to fit the hole in the fork and a V to center the neck with a clamp of some kind would suffice for many pieces. Still another suggestion is a two-jawed chuck, one jaw having a V to center the end of the fork and the other a plain stop for the rod end. This method on a screw or chucking machine insures excellent work. Another pair of jaws suitably fitted would provide for the rod hole.

It is a mistake to attempt too much simplification in jigs, and it is just as fatal to indulge in extravagant uniqueness or needless complexity. It is particularly short-sighted to make in one piece that which can be more easily made in two or more. If "Gutta Gitta's" jig must be made on the lines laid out, it would be better to abandon the box effect and mount his clamp screw in a separate block, as shown in the accompanying illustration. It would be just as effective and more easily made and cleaned. With sufficient space at *X* the machining could be done on a milling machine. In "Gutta Gitta's" design it is a shaper job, ugly to handle and unsatisfactory, although there are men who will declare it O. K. and just as easy. Experience has taught me, however, that this type of jig is usually to be avoided.

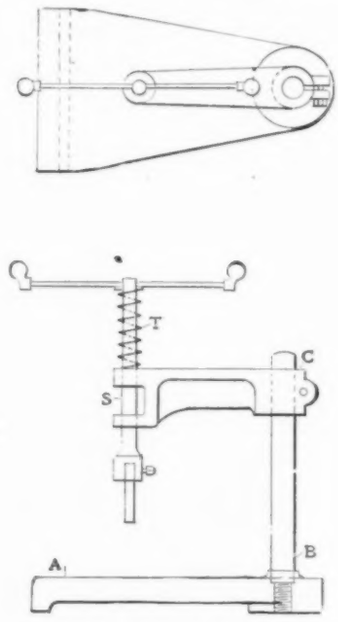
PRINCEPS.

A Hand Tapping Fixture

The acompanying sketch will almost explain itself. I have found it a very efficient fixture for various kinds of manufacturing purposes as well as tool-room work.

The base *A* is of cast iron, having the upright *B* firmly fastened to it as shown. The arm *C* is clamped to the upright, but can be adjusted if special length of tap or hight of work necesitates. The spindle *S* is a free fit in the arm *C* and the spring *T* is simply stiff enough to carry the weight of the spindle with ordinary chuck and tap.

Where regular manufacturing is done with this fixture I have found it useful to have a plain hole to fit the shank of the tap, keeping it from turning by set-screw *D*, which construction is shown in this sketch. It is obvious that any form of drill chuck could be substituted to hold the tap. The advantage of this fixture is



HAND TAPPING FIXTURE

readily seen, as all holes are tapped absolutely square with the base, without any material experience or effort on the part of the operator.

I would add that this design has been used in various sizes with entire success, of the operator.

H. B. FOSTER.

The Machine Tool Builders' Convention

Uniform Cost-accounting and Apprenticeship Leading Subjects Discussed. Special System Recommended by Apprenticeship Committee

EDITORIAL CORRESPONDENCE

The regular semi-annual convention of the National Association of Machine Tool Builders was held according to program at Fortress Monroe, Va., May 14 and 15. The session of Tuesday morning was an executive session and was devoted chiefly to enrollment, organization, the reading of the president's address, the appointing of committees and the hearing of reports from committees.

The Cost of Machine Tools

The session of Tuesday afternoon was devoted chiefly to the subject of the determination of the cost of machine tools. The report of the committee on this subject was read and discussed, and following the report came a paper by B. A. Franklin, describing and illustrating at length his system of cost accounting.

The report of the committee is not an attempt to lay out a system of cost accounting, but to present a general outline of the subject, chiefly by means of a chart of accounts, to the end that a uniform basis shall obtain regarding the items which shall be considered as entering into the totals of the cost of production and of selling. The report includes a number of leaflets, each relating to a specific item of cost, with a blank space for each member to enter his own practice and opinions regarding the various points. It is the intention of the committee, after getting these reports from the members, to collect and classify them, and at a later meeting to bring in a complete report—the present one being essentially a report of progress. The report is of large merit, and even in its present form, provides abundance of food for thought. Looking back to the time when this subject was first opened for discussion in the association, the present report marks very substantial progress and gives good ground for hope that it will eventually lead to a large amount of education among the members, and do much to eliminate the universal tendency to underestimate costs when imperfect systems of cost accounting are followed.

A Cost-accounting System

Mr. Franklin's paper presented something distinctly new in cost accounting. The usual methods of cost accounting, no matter how good they may be, are essentially of the nature of a single-entry set of books, there being none of the automatic checking which is an integral part of the double-entry system. In Mr. Franklin's system this checking is introduced for, we believe, the first time, and it applies to all of the items, except one, this being the value of raw material on hand, of which it is necessary to take an occasional inventory in order to check the figures shown in the books. The method also attacks the problem from the top instead of, as usual, from the bottom. By this is meant that the system may be inaugurated in such a manner as to give the totals of cost only, without first obtaining and then adding the cost of various parts. As production increases, and as detailed costs become desirable, they are obtained by a simple system of sub-division, which may be carried to any extent desired; and the plan of finding the total and the detailed costs, may be followed at the same time, one plan being applied to one line of products, and the other plan to another line.

Mr. Franklin's paper was illustrated with a series of enlarged blanks and account-book page forms—these various exhibits being of such size to be seen across the room. The paper was listened to with much attention and a hearty vote of thanks was voted at its conclusion.

Apprenticeship

The session of Wednesday morning was devoted to the reading and discussion of the report of the committee on apprenticeship. The committee proposes two systems of apprenticeship, the first being general and covering the entire machinist's trade, as apprentiseship has always done, and the second a special system, covering a single branch of the trade only. The committee submitted complete papers covering both systems, for discussion, which, however, are to be modified to cover points brought out in this discussion.

The idea at the base of the special apprenticeship system is that in the present condition of the machine-manufacturing industry the chief demand is for specialists, and also that, by reason of the shortened time in which a man may become proficient in a single branch of the trade, it is possible to pay materially higher wages to special than to general apprentices, and thus attract many young men who must have a living wage, but who cannot live on the wages which can be paid to general apprentices.

With both systems it is proposed to supply the apprentice with a set of tools at the beginning of his apprenticeship, which are to remain the property of the employer until the completion of the term, at which time they are to be given to the apprentice. The committee also recommends that at the completion of their terms the apprentices be presented with diplomas, naming the shops where, and the branch of the trade to which they have been apprenticed, the diploma to bear the seal of the National Association of Machine Tool Builders.

Wage Rates to Apprentices

The length of the general apprenticeship is to be three years, the wages paid being 8, 10, and 13 cents per hour. The special apprenticeships are to be shorter, and the rates higher. Thus, for turning and planing the course is to cover two years, the rate of wages advancing each six months, and being 12, 14, 16, and 18 cents. For the vertical and horizontal boring mill the term is to be 1½ years, the rate advancing at the end of each six months, and being 15, 17, and 20 cents. In the case of drilling and milling, the term is to comprise a single year only.

This special apprenticeship system is the outgrowth of an experiment made at the Bullard Machine Tool Works, and which, according to E. P. Bullard, Jr., who presented the report, has been very successful. It has been found feasible to train very efficient men and to largely increase their earning capacity in a brief period of time. Some of those taken in have been beyond the usual age of apprenticeship, the applicants being men of natural ability, but working as laborers only, and a good proportion of them have increased their earning capacity threefold. In other cases it has been possible to obtain farmers' sons who were unable to take the general course, because of the lower wages, but who, by reason of the self-sustaining wages offered at the beginning of the special courses, have been able to take those courses and have done so. The report provides for the transfer of an apprentice from the special to the general class, with suitable credit for the time served, Mr. Bullard stating that in some cases young men had begun with a special course, saved up money from their wages, and then taking the general course, living for a time partially upon their savings.

Mr. Bullard's idea was that eventually the general apprenticeship course would become largely a means of training superior men for the positions of foremen and traveling representatives.

The committee was continued, and it may be said that its report, like that of the one on cost accounting, marks substantial progress in the work of the association.

Industrial Education

Following this report came the report of a committee appointed to attend the meeting at which the Society for the Promotion of Industrial Education was organized. The committee enlarged upon the evidence of large interest in the subject of industrial education, which the organization of this society shows, and it recommends the members of the association to become members of the society, its only criticism of the society being that its aims are so very broad that fears of a tangible outcome are naturally aroused.

Following this came the report of the committee which attended the convention for the extension of foreign trade, held last winter in Washington. This convention was attended by over 500 delegates, and was declared by the committee to have been the most important meeting for the purpose specified that has ever been held. The report of the committee included a list of the recommendations to Congress which were passed by the convention.

Six Months' Death List

Following this came a report of the resolutions committee, recording in suitable form the sorrow of the association over the loss by death during the past six months of no less than four of its leading members, these being E. P. Bullard, Jos. Flather, H. J. Hendey and H. C. Hoefinghoff.

The Responsibility of Foundrymen

Next came a discussion, which was opened by C. H. Norton, on the responsibility of foundrymen. Mr. Norton enlarged upon the haphazard methods, and the lack of responsibility which everywhere attend the foundry industry. He described the operations of the foundry in graphic language, as being the making of a hole in the ground with the aid of the customer's pattern, pouring some melted iron in the hole, and sending the result to the customer. He pointed out that machinery builders must deliver a workable product to their customers, and he contended that the foundries should also be required to deliver usable castings. He instanced one case of a casting which should have weighed 600 pounds, but which as it came from the foundry weighed over 1200. He asked the members if they ever knew a foundry which would return a pattern and return it all. His company finds it necessary to employ a man whose exclusive duty it is to visit the foundries, identify their orders, hunt up the required patterns and chalk the required number of castings on each pattern. He declared that an order for a given number of pieces meant nothing to a foundryman, and that the only way to get the required number was to have it chalked on the pattern. His company has another man, who spends his entire time inspecting castings after they have been received and the freight paid for, in order to find if they can be used. All this leads to delay and to increased expense. He contended that it should be possible to send an order to a foundry and to receive satisfactory goods in return precisely as machine tool builders are expected to follow an order with satisfactory goods.

The subject was referred to the existing foundry committee, with the recommendation that they take action, fixing the responsibility of foundrymen.

The Profitableness of Exhibitions

The next subject discussed was the profitableness of exhibits at expositions. The feeling of the convention was practically unanimous that since the world's fair at Chicago, expositions have been very much overdone in this country, and that while exhibits at special exhibitions like those of the Railway Master Mechanics' Association undoubtedly pay, exhibits at general exhibitions undoubtedly do not. There was, however, a decided division of sentiment regarding European exhibitions. The opinion was expressed that in Europe consumers visit exhibitions in order to learn of progress in their art to a much greater extent than in this country, and that consequently exhibits pay much better there than here. The discussion was closed by a motion to appoint a standing committee on exhibitions, whose duty it should be to investigate the scope and purpose of exhibitions as they are proposed and exploited, and be ready to report to members their findings as they are called for.

F. A. H.

Connecting-rods for Automobile Engines

By Belsize

The sketches show some jigs and fixtures for machining automobile-engine connecting-rods, of which we do large quantities, shown in Figs. 1 and 2, drop forged of steel.

FIG. 1

FIG. 2

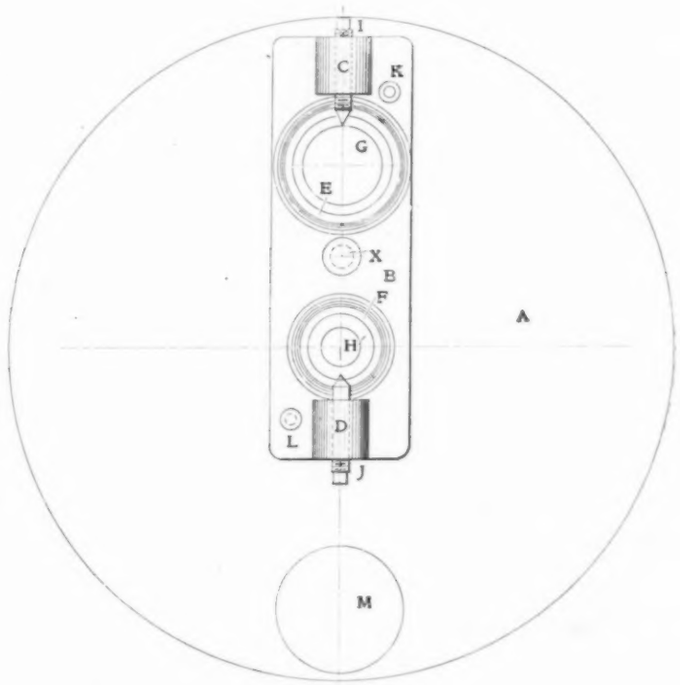


FIG. 3

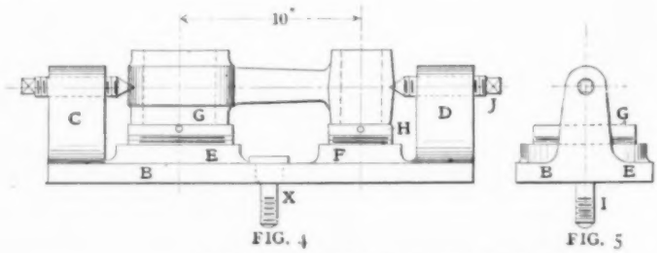


FIG. 4

FIG. 5

FIXTURE FOR BORING BOTH ENDS OF RODS

The first operation is to true up the two faces marked *X* in Fig. 1. This is done on a disk grinder and occupies about two minutes each, after which they are taken to a small centering machine, with a horizontal table, adjustable vertically, and centered at both ends with a Slocomb center drill. A small collar is clamped on to the centering drill to act as a stop for

correct depth, or rather to insure all the center holes being the same depth, which is an important item.

Boring the Rods

The next operation is to bore the ends of the rods for the gudgeon or wrist pin, and for the crank-shaft brass bushes. This is performed on a capstan lathe, with the headstock and capstan slide raised on blocks to get the necessary swing, and the fixture shown in plan in Fig. 3, fixed on the large face plate *A*.

A gray-iron casting *B* is accurately planed on the bottom and carries solid brackets *C* and *D* at each end. These brackets are bored and tapped to receive the two pointed center screws *I* and *J*. *E* and *F* locating pegs *K* and *L* are then screwed out and the fixture carrying the rod swung round, bringing the opposite end into line with the turret; *K* and *L* are then tightened up and the other end machined. It will be seen that by this method all the centers of the rods are absolutely alike, a very vital dimension, and giving trouble in assembling if not bored accurately.

We had previously tried other methods, such as securing the rods directly on the fixture by means of clamps, but found that this method caused a slight "spring" in the rods, however careful the operators were. The result was that the holes were not parallel with each other, and consequently the rods had to be scrapped, a serious item. Since using the centers, however, we have eliminated that trouble, and the work comes out true to gage.

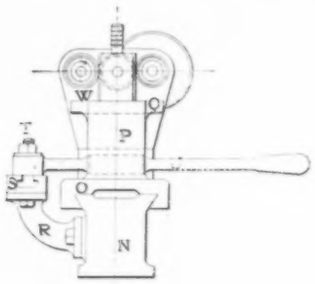


FIG. 7

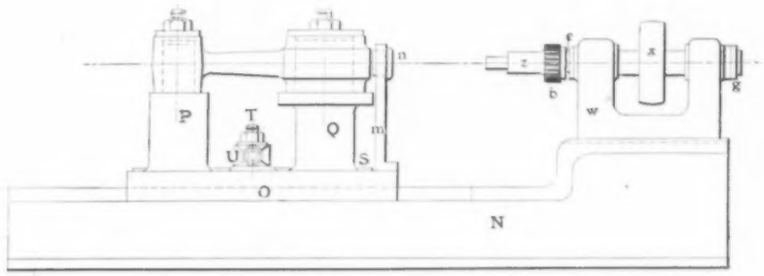


FIG. 6

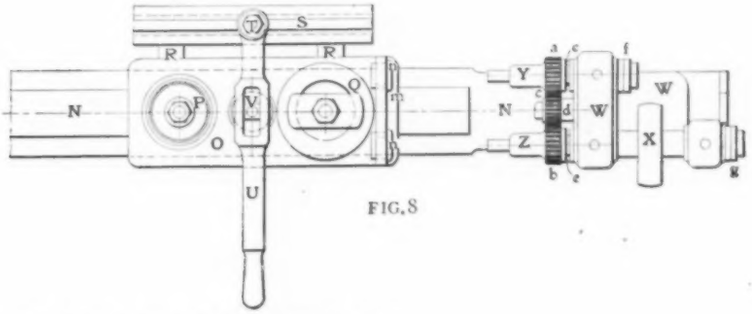


FIG. 8

MACHINE FOR BORING BOLT HOLES FOR CONNECTING RODS

are two bosses, shown in Fig. 4, bored out and threaded to receive the two screwed adjustable collars *G* and *H*, made of steel tubing. Each of these has four holes drilled round the top for a peg spanner. *K* and *L* are two locating screwed guide pegs, *X* being the central pivot pin, which passes through the face plate, the nut at the back securing *B* to *A*. The hole in *B* for the pivot pin *X* is bored exactly midway between the two horizontal lines which indicate the centers of the two holes to be bored. *M* is a balance weight to give an even turning movement to the face plate.

The rods are placed between the centers, as shown in Fig. 4. The steel adjusting collars *G* and *H* are then screwed up against the ground faces of the rod, and thus fasten it securely in position. The locating pegs *K* and *L* are then tightened, and the rod end is bored, faced and radiused to size. One end completed, the

Boring Both Bolt Holes

For boring the bolt holes we designed the fixture shown in Figs. 6, 7 and 8. *N* is a gray-iron bed, planed top and bottom, to receive the slide *O* at the lower level. *P* and *Q* are two projecting bosses, planed on top for securing the rod, which is shown in position in Fig. 6. The two brackets *R* support the slide *S*, which has a T-slot milled in for carrying the bolt *T*. This secures the lever *U*, which is used for the hand feed and has a slot *V* milled cut. *U* operates through the square block shown in Fig. 8. This fits on a stud shown in the center and is screwed into a short boss in *O*. The headstock *W* is offset to carry the main spindle and the driving pulley *X*. *Z* is one drill spindle, on which a pinion *b* is cut. This gears with a reversing pinion *c*, carried on the stud *d*. *c* in turn drives another pinion *a*, the same size as *b*, and solid with *Y*, which carries another drill and is pitched the exact distance from *Z* to suit the two bolt holes in the connecting-rod. Two ball thrusts *e e* take the end pressure when drilling; *f* and *g* are lock nuts for securing the spindles *Z* and *Y*; *m* is a gray-iron ribbed bracket, bolted on to the front end of the slide *O*, as shown in Figs. 6 and 8. This bracket carries the two jig bushings *n*, which support the horizontal drills and save marking the rods.

The rod is clamped in position by the two locating studs shown, and the stud *T*, which secures the rod *U*, is adjusted in the slide *S*. The drills are then started, the operator puts the feed on by pressure on the lever *U*, and drills both the ½-inch bolt holes at the same time, effecting a considerable saving of time.

With these fixtures we have completed over 250 rods and find that they give us the quickest and most accurate method we have yet devised.

Makers of six-cylinder cars assert that there will be a shortage of that type of automobile, and that this condition will develop in an acute form before early spring deliveries are well under way.

According o the *Railway News*, a meeting was recently held in Pittsburg to discuss the feasibility of establishing there a museum of railway relics of historic interest. It was pointed out that early engines possessed for young engineers considerable educational interest, and that there should be no difficulty in establishing a really valuable collection.

Shop and Engine-room Notes

By C. W. Crawford

One of the hardest things to teach the boys in the shop is to use the heavy sledge instead of the light one to back out a tight key. The light blow upsets the key and makes it tighter, while the heavy one shoots it out at the first blow.

Another difficult thing to pound into the boys' heads is the fact that a key should be fitted tightest at the point. The heel is then upset in driving, insuring a tight fit at both ends.

Tallow well mixed with flake graphite is the best known lubricant for reamers, whether used by hand or power. On the other hand, hard tool steel is drilled more easily without oil of any kind.

When tool steel is welded there is always a film of iron between the adjacent parts. This can be seen plainly by polishing a cross-section of it. The film will not harden.

Life of Hack Saws

The duration of the life of a hack saw, or of a machine saw, depends on the speed at which it is made to cut. The jerky motion usually given a hand saw ruins it in a few strokes. Like all other tools it should have a uniform cutting speed of so many feet per minute, say 12 feet, and the work done by one saw at this slow speed seems incredible when compared to that of the usual rip-tearing hand method.

It cannot be expected that all machinists will grind their tools alike, but occasionally you find one who grinds his chisels hollow in the middle, that is, concave across the edge; and sometimes when you take an idle lathe to do a job, when the man is off for a day, you find not a single tool you can work with. This condition is found among men whose shop education has been neglected; from shops where the apprentice system is claimed to be a failure, where the apprentices, if any, have "just growed."

The Old Diamond Point

The later forms of tool holders for lathe tools introduce a happy relief from that unconscionable old nuisance, the "diamond point." But there are those yet who insist on using it when they can get it surreptitiously. I refer to the forged tool whose point stands up in the air from the bottom of the bar, forged square but angular, and whose top face is diamond shape. That is the one; the worst tool that was ever invented, requiring twice as much grinding as any other shape, and then it cannot be made to take a decent cut. Its extinction is a godsend to the lathe fraternity—and shop owners as well.

Collapsed Exhaust Pipes

Not all of the engineers of this generation have seen a 'scape collapsed flat. In the olden times 'scape, or exhaust, pipes, were made of tin; on frosty mornings when the engine was started abruptly without warming up, the first rush of steam condensed instantly and the tin pipe went flat. This was before the time of gas pipes. In those times pumping engines—the steamboat Doctor, for instance—gave much trouble by the concussion or pounding of water in the pipes where single-acting pumps were used. The momentum of the water carried it forward during the return stroke, leaving a vacuum behind it, and causing a severe thump at every stroke. This concussion was relieved by placing a Mississippi gage cock somewhere in the pipe near the pump, and in the under side of the pipe with the steam of the gage cock downward. This acted as a relief valve, the valve drawing inward at every stroke, and by admitting air entirely relieved the noise.

About Air Chambers

It frequently happens that the air chamber of a pump is too small, or it becomes waterlogged, causing a terrific pound in the pipes. This is easiest relieved by placing a small air cock in the suction pipe, admitting a small quantity of air sufficient to keep the air chamber constantly charged, for the water under pressure absorbs the air, and it must be supplied by some means. A sufficiently leaky suction pipe will do the trick, but it is likely to overdo it and spoil the whole job.

Water Hammer in Pipes

In the large hoisting engines used in coal mines the most destructive force the engineer has to contend with is that of "water hammer." The main steam pipe is usually carried under the floor to the throttle valve and branch pipes, and being of considerable length, condensed water collects when standing idle for even a short time (unless the drain cock is kept constantly open). Upon starting the engine this water is started in motion, slamming back and forth with such terrific violence as to burst elbows and valves.

The safest relief from this affliction is to keep the drain cock open, even if it does waste a little hot water, and the next best relief is a pop safety valve. A partial relief is sometimes provided by casting a pocket in the elbow and filling it with rubber, on the principle of putting a billet of wood in the rain-water barrel to prevent bursting by freezing.

Sometimes this condensed water is carried forward into the cylinder with the result of breaking something; when this occurs with the engine in full motion, the piston strikes the water at a point near the end of the stroke so quickly that it hasn't time to escape back into the steam chest, when the crank and connecting-rod are close to the toggling point and the large heavy drum is in rapid motion. The strain is terrific, sometimes springing the cylinder bolts and forcing jets of water in every direction through the ground joints and jamming the cylinder cocks.

This is an illustration of the strongest known mechanical force, and curiously enough, while this may happen frequently within the breaking limit, the ground joints will still remain steam tight, owing to the elasticity of the bolts. But this practice generally ends sooner or later in a broken piston or cylinder head.

Packing Rings

Articles as largely used as packing rings would appear to need the best attention of engine builders, but the reverse seems to be the more common practice. A large proportion of builders appears to regard any old thing good enough for a packing ring. The style most in vogue is a plain ring cut diagonally and sprung into the groove, free to turn round, and to leak. Some cut them with a half lap, but they leak just the same, and the laps break off. Others rivet a lap piece under the ring. This makes a better job, and does not leak, but it is liable to break at the lap or at the rivet holes.

Others again make the ring in three pieces, three rings, two outside and one inside, and the cuts placed apart to break joints. This is better still, but the face rings have to be so narrow that they also are liable to break. Some use two rings or more, and others only one. When the piston wears down, it offers an easy outlet for a lot of steam each stroke. When it happens that the cut gets turned around to the bottom, the head covers the joint, and it is steam tight for the time being. This introduces the only good feature about any of these rings, that the cut ought to be kept at the bottom and held there by a strong pin in a hole filed in the ends of the ring. In this case the cut ought to be square across to prevent breakage of the corners, and there ought to be two grooves and two rings and each cut a little to one side of the middle. This makes the best job of all the cheap rings.

History That Isn't So

There is very little fault to be found with the old-fashioned spring packing, or the "Dunbar," if properly made, except that it is hardly ever looked at until the engine refuses to move; or, as it sometimes happens, it is overlooked too much and to its disadvantage. All round, the cheap rings are the safest, for they cannot easily be tampered with. A single ring with the cut at the bottom is absolutely steam tight.

I have found in a voluminous history recently published, called the "Making of America," the statement that the drop cut-off and the Corliss engine were invented by "Joe" Corliss (!) whom engineers have heretofore known by the more dignified title of "Corliss." Just imagine Jim Watt! or Dick Trevithick! or Jack Hornblower! But such is history.

Improving a Milling Jig

By George G. Little

The sketches inclosed show how a defective jig was made to stand up under the work and give less trouble in getting the work out.

The work consists of gray-iron castings, being a side frame for a light complicated machine of interchangeable parts. The web of the frame is of I section, and there are between 25 and 30 bosses which extend on each side beyond the web, as at *B*, Figs. 1 and 2.

These bosses are milled or machined to ⅜-inch thick, an equal amount being taken off each side on a Pratt & Whitney two-spindle profiling machine. A roughing cut is taken of about 0.030 inch and a finishing cut of about 0.003 inch with high-speed end mills.

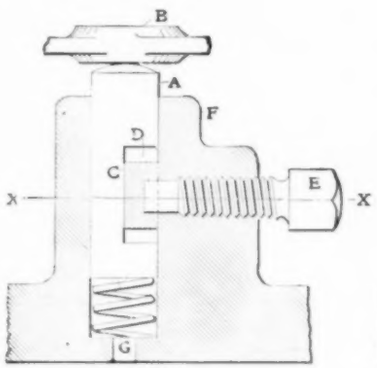


FIG. 1

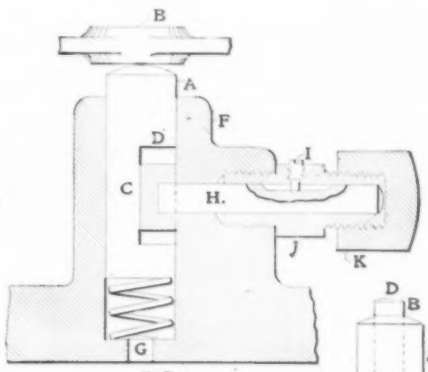


FIG. 2

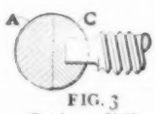


FIG. 3
Section at X X

FIG. 4

FIG. 5
Block C for Pin H.

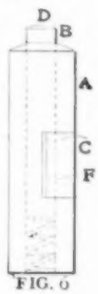


FIG. 6

DETAILS OF JIG IMPROVEMENTS

When the frame is placed in the first jig it is held by three stationary clamps and also three floating clamps, which, after being adjusted to the work, are locked to the jig. These clamps are not shown.

After the clamps are all fastened, the set-screws *E* are loosened, allowing the spring pins *A* to come up against the under side of the work *B*, Fig. 1; then the screws *E* are tightened again.

It will readily be seen that by tightening the screw *E*, Fig. 1, the half-round block *C*, in the chamber *D*, will be forced against the pin *A* and hold it by friction between the block *C* and the side of the hole in the jig *F*.

The Theory of It

The supposition is that the block *C*, being a nice fit on the end of the screw *E*, also fitting closely between the flat part of the pin *A* and the side of the hole in *F*, there would be no trouble of clamping the pin at the point of rest when it becomes stationary against the boss at *B*.

This seemed to be true while everything was new and the bottom of the hole in *C* and the end of *E* were smooth and clean. But just as soon as the end of the screw began to wear and get dry and cut, the trouble began.

Sometimes a pin would let down, and when the boss was finished it would be 0.003 or 0.004 inch full; or perhaps the pin would be forced up, springing the work up 0.003 or 0.004 inch, thus causing more stock to be cut off than should be.

The raising or lowering of the pin when the screw was tightened was caused by the point of the screw becoming dry and cutting, making the surfaces rough and uneven and binding more on one side than on the other.

How It Works Out

If it was more on the up side, while tightening the screw *E* the block *C* would move upward 0.0005 to 0.005 inch causing the pin *A* to move up with it. When the pressure or roughness was on the down side, the reverse would be the case, causing the work to be left full and uneven.

This gave me so much trouble that I studied the thing over; when I found the cause of the trouble, I had the method of clamping the pins changed so as to eliminate the up and down movement as much as possible after the pins *A* were settled against the work. To do this it was necessary to find some means of clamping the pins *A* without a turning or twisting movement.

As the jig was an expensive piece of work, it would not do to make too much of a change. I wanted to have the 5/8-inch pins *A* taken out and ¾-inch pins made as shown at Fig. 6, but the size of the bosses in which the pins are held would not admit of a large hole being bored and leave metal enough around the hole to stand the pressure of the pin *H* when the nut *K* was tightened. The method shown at Fig. 6 is one which Brown & Sharpe use on their automatics for holding drills and reamers in the turrets.

As a preliminary trial the blocks *C* were made with the bottom of the hole convex, as shown at Fig. 4. The point of the screw at *L* is flat and hardened, as are the blocks *C*.

These blocks did not answer our purpose, as the convexed bottoms of the holes caused the points of the screws to split and spread. The screws were of ordinary set-screw stock, carbonized. Fig. 3 gives a cross-section of the pin *A* and block *C* of Fig. 1 at *x x*.

The Final Change

In Fig. 5 are shown two views of the blocks as made up for the final change, and as they are now being satisfactorily used. Fig. 2 shows how the 5/16-inch tapped hole for the screw *E* has been counterbored and retapped for a 9/16-inch threaded sleeve which has a cap *K* at the outer end. The sleeve *J* is ¾ inch in diameter and is drilled and reamed to fit a 5/16-inch pin *H* of hardened drill rod. The pin *H* has a groove in which the point of the screw *I* is inserted to prevent the pin revolving while being forced against the block *C*.

After these blocks, pins, sleeves and caps had been in use for a few days I found little weaknesses here and there. The pins were hardened on the ends for about ¼ inch, and soon began showing the effect of the pressure of the caps by swelling in the center and sticking in the holes, causing pins *A* to stay locked. Then some of the sleeves parted at the shoulders and one or two of the caps had the centers pushed out.

The sleeves were made of cold-rolled steel, carbonized, and the caps were made of tool steel and hardened, then drawn to a dark brown.

A wrench about 4 inches long is used on the caps and I find that it takes quite a bit of pressure to make the pins tight enough to withstand the constant jarring and pressure of the end mills.

Though the cutters have a 45-degree cutting corner there is some downward pressure on the work, which will cause the pins *A* to settle unless securely clamped. This jig is in almost constant use and does not cause half as much trouble and worry to the operator as formerly. The pins *A* have a flat top about ¼ inch in diameter. The work is japanned before being machined, and I find it necessary to remove nearly all of the japan from the bosses which come in contact with the tops of the pins, to insure a firm surface for the pins to support.

This shows that we cannot depend on any sort of a set screw for holding accurate work, as the turning movement may easily throw it out of true.

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The Passing of a Noted Engineer

To but few laymen and to no other engineer has been accorded the privilege of living through such an extended period of mechanical evolution as Charles Haswell witnessed during his nearly one hundred years of life which drew to a close on May the 12th.

Born in 1809 and early developing an active interest in marine-engineering matters he was destined to be an observer of nearly every stage of progress so far made in this country in ship construction and to formulate and take a leading part in many of the important steps which led from the early steamboats plying the rivers and harbor of New York to the present-day ocean leviathans. As a boy he saw the "Clermont" which, launched by Robert Fulton in 1807, was in practical transportation service on the Hudson river for several years; and nearly a century later, still energetic and in unimpaired health, he witnessed the launching of the "Hendrick Hudson," the finest vessel yet placed in the passenger service between New York and Albany.

His was the opportunity of watching the evolution from the diminutive craft driven by engines and paddle wheels of crude construction and operated under steam pressure of a few pounds per square inch, to the much larger and better proportioned designs of hulls, with gradually improved machinery involving the employment of higher and constantly increasing steam pressures, and leading eventually to the modern marvelous examples of ship architecture in which are incorporated mechanical equipment and features of power and speed undreamed of by the originators of the "Clermont" and other vessels of her day. His period of activity as naval engineer and later as civil and consulting engineer in New York, extended over the reach of years linking the slowly propelled steamers of three-quarters of a century ago with the reciprocating and turbine grayhounds of today. Joining the "Fulton," one of the United States navy's earliest steam vessels, in 1836, as chief engineer, thus becoming the first engineer-in-chief of our navy, he was destined to be an eye-witness nearly seventy years later of the launching of the 16,000-ton battleship "Connecticut," which at the time her keel was laid was designed to be the most formidable naval vessel yet projected by any government.

The fifteen years in which he was engineer and engineer-in-chief of the navy, marked many forward steps in ship construction and marine-engine design, in which none played a more important part than did Charles Haswell. The difficulties and obstacles he met with in his work of advancing the science of naval engineering in opposition to certain over-conservative, ignorant or bigoted officials then in authority, serve as a peculiar commentary upon the Navy Department as then constituted.

Special Apprenticeship

We hope that no reader of the AMERICAN MACHINIST will fail to take note of the plan proposed by the committee on apprenticeship of the National Association of Machine Tool Builders, which is published elsewhere in this issue as part of the report of the convention at Fortress Monroe, Va.

For years the changing conditions in the machinery-manufacturing industry as regards the increasing specialization which runs through the entire industry, from the product of individual shops to that of individual workmen, has been discussed almost without limit, but until recently the entire subject of apprenticeship has been discussed as though the conditions of the shops were the same as those of forty years ago. It has been assumed as a matter of course that an apprenticeship course should be made to cover the entire trade of a machinist in order to produce all-around workmen, the fact that the percentage of such workmen employed in the manufacturing shop grows less and less every year being entirely ignored. This committee, or, to speak more accurately, the Bullard Machine Tool Company, from whose practice the idea comes, appears to have been the first to recognize the changed conditions, and to recognize that if the great majority of workmen are to be specialists, the apprenticeship course or courses should recognize that fact, and train men for the work which they are to do.

We have no doubt that a chorus of objections will go up, based on the idea that even though a workman is to become a specialist, he will be a better specialist for having had an all-around training. This, of course, is undeniable, but it is equally undeniable that he would be a better workman for training in many other lines which he has never had, and, just as good results have been obtained by ignoring these other lines, so we believe good results may be obtained by ignoring the general shop training.

"It is a condition, not a theory that confronts us," and it seems to us plain that the plan proposed meets the conditions which must be met. Among these conditions perhaps the most serious is the difficulty of attracting boys to the shops by the rate of wages which can be offered for a general apprenticeship course. If an apprentice is to receive training in all departments of the trade every transfer from one department to another leads, for the time being, to a loss of his efficiency so far as output is concerned, whereas in a special apprenticeship course his progress is continuous and his efficiency constantly increases. He thus attains a good

rate of efficiency in, comparatively, a very brief time, and the great difficulty of the small output of apprentices is met at once. Along with this goes the possibility of a marked increase in the rate of wages offered, and the Bullard Machine Tool Company has found it practicable to offer rates which are attractive because they enable the apprentice to be self-sustaining practically from the start.

At the same time, the plan proposed will, we believe, be found to largely overcome the question of expense in instructing apprentices. Any instructions which may be given to a general apprentice in connection with any one line of work leads to but little immediate result, because, if he is to be transferred to another line as soon as he obtains proficiency in one line, the efficiency already gained is largely lost, and the tendency is to slight such instruction. Under the special-apprenticeship plan, on the other hand, deliberate instruction will be reflected in an immediately increased efficiency and such instruction will be given because it will be found immediately profitable to give it.

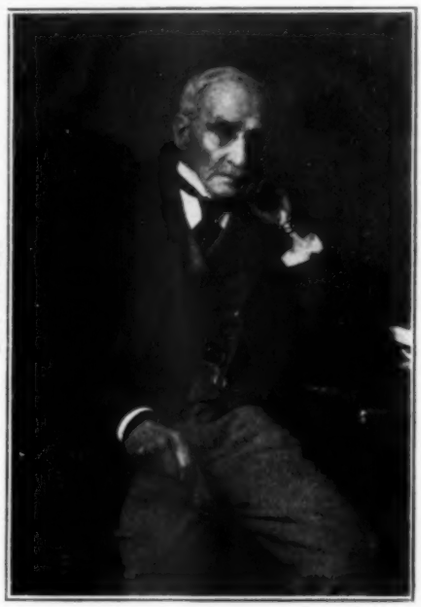
The entire plan seems to us so eminently practicable as to lead to wonder that its recognition has been delayed so long. We expect to see its application grow, and grow rapidly, and to see it produce results of large importance.

Charles Haynes Haswell

Charles Haynes Haswell, the oldest civil engineer of note in the world and one of the most distinguished marine engineering experts, died at his home in New York City, May 12, in his ninety-eighth year, his death being due to a shock attending a dislocation of the shoulder, which he had sustained the day before in slipping and falling on the floor of his house in West Seventy-eighth street. Up to the time of his accident he was in good health and, although so nearly 100 years of age, he was regularly at his work in charge of important construction operations for New York City.

Mr. Haswell was born of English parents in this city, May 22, 1809. At the age of 19 he finished his schooling, which had been along classical lines, and, having inclinations toward a technical career, he secured employment in the engine works of the pioneer establishment of James P. Allaire. While with this firm he was selected by the United States Navy Commissioners to take charge of the building of a steam war vessel for the Government and in 1836 joined the United States Navy as chief engineer, receiving his commission as engineer-in-chief in 1845. Some years prior to this date he conceived the idea of building a steam launch and in 1837 constructed the "Sweetheart," which was the first private steam yacht launched. He held the rank of engineer-in-chief of the navy until 1851, and during that period designed the machinery for ten war vessels and introduced numerous mechanical improvements for increasing the early steam navy's efficiency.

His aggressiveness as a practical engineer and his ideas due to his mechanical training involved him in frequent controversies with the naval authorities. When the old "Missouri" some fifty years ago was about to start for the Mediterranean, a proposition was submitted to the Secretary of the Navy that the funnels then in use be replaced by two horizontal pipes leading into the wheel house, the idea of the inventor of the scheme being that the smoke from the fires would be concealed from the enemy by being drawn from the furnaces by the suction of the paddle wheels. The proposition was indorsed by the secretary; and Mr. Haswell, who fought against the project as an im-



CHARLES HAYNES HASWELL

practicable idea, was suspended from the service. The arrangement was given a trial, which was witnessed by many prominent government officials, and upon its proving a complete failure, Mr. Haswell was notified that if he would apologize for his action he would be reinstated and could proceed with the ship. This he refused to do, and as a result was detached from the service. He was, however, shortly after reinstated and later was appointed to design and superintend the building of the machinery for several revenue cutters. In 1843 he was ordered to Washington to discharge the duties devolving upon the engineer-in-chief, and in 1845 he was promoted to that position, which he held until 1851, when President Fillmore appointed a civilian to supersede him, later, however, restoring to him his rank as senior chief engineer.

In 1847-48 he designed the entire boiler and engine equipment of the steam frigate "Powhatan." Owing to a lack of professional aid, and the urgent requirements of the service and the contractors, he was compelled to personally design every detail and made the working drawings himself in the intervals between attention to the necessary duties of his office as engineer-in-chief. The design of the engines was novel in several respects and wholly so in the fact that they were set in wrought-iron frames, the first construction of its kind. The "Powhatan" had a length of 250 feet and a displacement of 3600 tons. The engines were inclined and the two cylinders were 70 inches in diameter, the stroke being 10 feet. The engines were designed to run at 13.5 revolutions per minute. The steam pressure was 10 pounds per square inch, the indicated horse-power 1100. The paddle wheels of this man-of-war of 60 years ago were 31 feet in diameter and the speed of the ship about 10 knots.

After retiring from the navy in 1851 Mr. Haswell built several merchant steamships and then engaged in engineering practice in New York. For over 40 years he was surveyor of steamships for the marine underwriters of New York. He designed and located the buildings on Hoffman island in the lower bay and built the crib bulkhead at Hart's island. He constructed what at the time were the most extensive and difficult building foundations in the city. For several years past he had supervised extensive work of construction and improvement at Riker's island. From 1855 to 1858 he was a member of the board of councilmen of New York City, and during the latter year was its president. Later he entered the employ of the city, and during his many years of service acted as chief engineer of the dock department, superintending engineer to the department of charities and correction and the board of health, and consulting engineer to the board of public improvements. He was appointed by the latter body in 1898 to design and supervise the extension of Riker's island, and in 1902 was appointed consulting engineer to the board of estimate and apportionment, which position he held at the time of his death.

Mr. Haswell first brought out his pocket-book, which is now in its seventy-second edition, in 1843, the volume at that time containing 284 pages. He was also the author of "Reminiscences of an Octogenarian," a book of memoirs covering the old New York from 1816 to 1860. He was a member of the Engineers' Club of New York and Philadelphia, and belonged to many engineering and scientific organizations, among these being the American Society of Mechanical Engineers, the American Society of Civil Engineers, American Society of Naval Engineers, the Institution of Civil Engineers and the Institution of Naval Architects of Great Britain.

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

Motor-driven Boiler-shell Drill

We illustrate herewith a new boiler-shell drill, which is motor-driven throughout and has been designed for the special purpose of taking advantage of high-speed steel.

As will be noted, there are two end housings, on the front face of which, carried by brackets, are two 5-inch bars on which are mounted two independent motor-driven drill-heads balanced by the two counter-weights; the bars have a vertical range of 6 feet and are raised and lowered by means of screws actuated by a motor on the top rail of the machine, this motor being handled by a reversible regulator on the inside of the housing which does not appear in the cut.

An especially noteworthy feature of this machine is the central position of the spindle, not only between the bearings of the drill-head on the bars, but also between the bars, so that the pressure of the drill against the work has no tendency to set up torsional or sidewise strains in the drill-head or bearings, causing excessive friction of the drill in the hole, rapid deterioration of the drill and undue consumption of power, owing to the spindle being thrown out of alinement.

The machine is entirely self-contained, all adjustments being effected by means of crank handles and hand-wheels, no wrenches whatever being required, and the operator has all the adjustments of the drill-head at his command from either side of said drill-head without moving from his position.

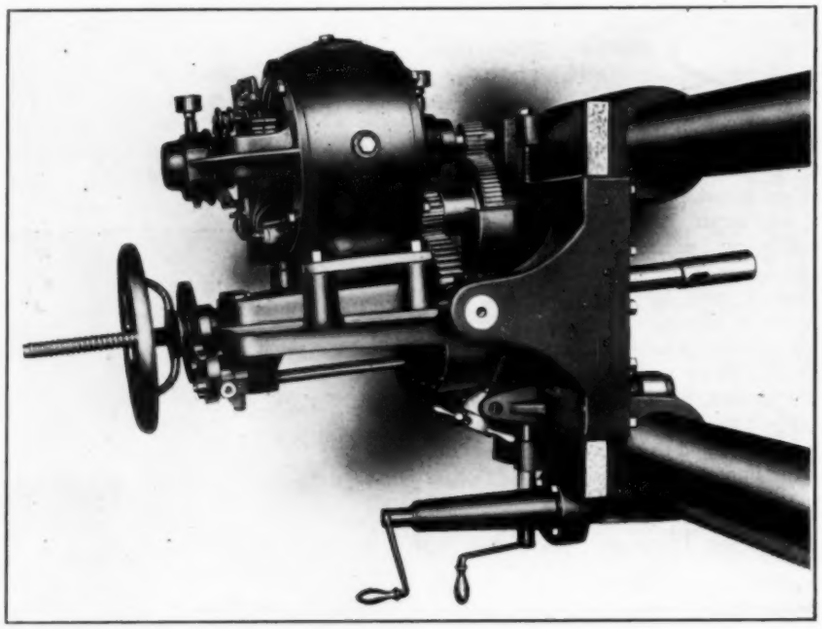


FIG. 2. ONE OF THE DRILL HEADS

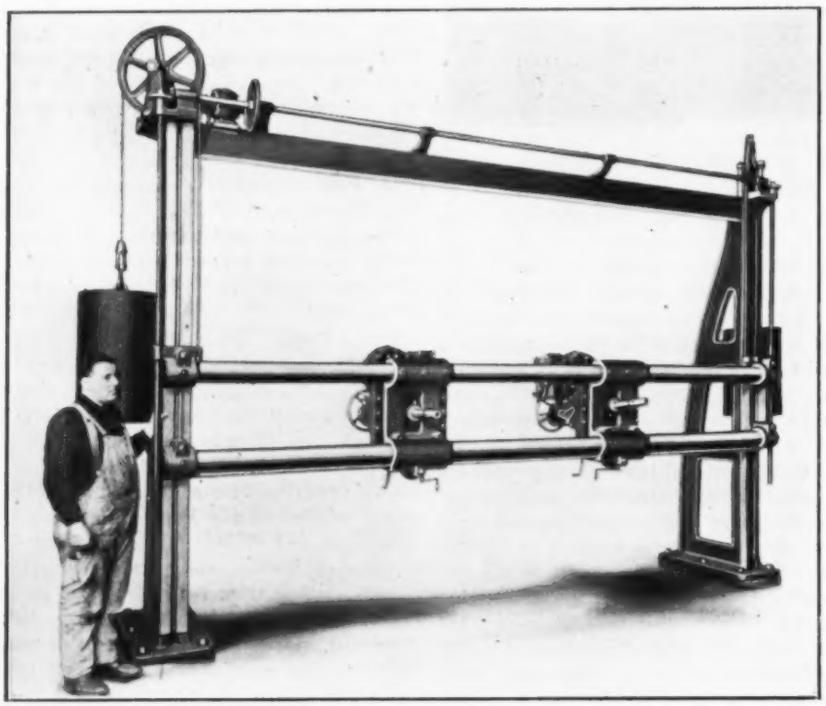


FIG. 1. MOTOR-DRIVEN BOILER-SHELL DRILL

In the lowest position of the carriage, the centers of spindles are 21 inches from the floor, and in its highest position, 7 feet 6 inches. The distance between the housings is 14 feet and the distance between spindle centers when the drill-heads are in their outermost position is 12 feet.

The length of the standard machine over all is 17 feet 8 inches, the hight 11 feet 6 inches, and the total weight 12,000 pounds.

Fig. 2 shows one of the drill-heads with its individual motor and illustrates the method of mounting the gear frame on trunnions. As this cut shows, each drill-head has a vertical adjustment in itself of 6 inches, operated by a crank handle at the bottom, and is moved along the bars by means of a pinion and rack on the under side of the lower bar.

The motors shown on these drill-heads are Northern 2 horse-power variable-speed motors, the regulating box and switch being mounted on the opposite side of the motor. There are no bevel gears used in the transmission from the motor shaft to the spindle, making a very durable and efficient gear reduction. The

spindle speeds range from 80 to 160 revolutions per minute, and the whole mechanism of the drill-head is especially designed and built for the purpose of using high-speed steel drills if desired.

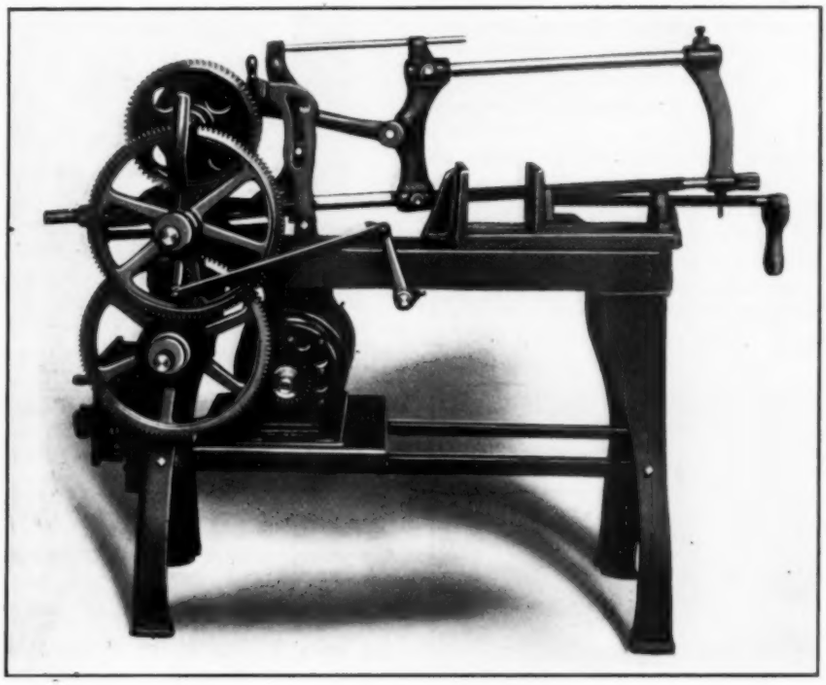
The spindle has a traverse of 18 inches and a perpendicular range through an arc of 15 degrees to permit drilling rivet holes radially to the center of the boiler, which is set on rollers in front of the machine. The last movement is controlled by the hand-wheel which appears immediately beneath the gear reduction. The large cut shows one drill-head with the spindle in a horizontal position, and the other with it inclined upward.

The feeding mechanism consists of a feed shaft, crank head, rocker-pawl plate, pawl, ratchet wheel, feed nut and feed screw, the thrust of the latter being directly upon the back end of the spindle. The connecting rod between the crank and rocker plate is fitted with a spring which can be set for any pressure of feed, so that it is impossible for this pressure to be exceeded, as the spring is compressed when the limit is reached, and the feed ceases to operate until the pressure is reduced, thus making an automatic relief. Change of feed is effected by shifting the thumb-latch around the crank head, and a range of feeds from 0.005 inch per revolution of spindle to 1/16 inch can be obtained. This range of feeds covers the entire requirements of drilling in boiler work.

The machine is built by the Thos. H. Dallett Co., Philadelphia, Penn.

Motor-driven Hack Saw

The power hack saw has become such a useful, if not indispensable, tool that its place is assured as a standard machine for years to come.



MOTOR-DRIVEN HACK SAW

This machine has the adjustable frame by which saws of various lengths can be used if desired. It is designated as No. 3, motor driven. The pinions are of fiber, bushed with metal. It is made by the Robertson Manufacturing Company, Buffalo, N. Y., who make eight sizes, the smallest cutting bars 4x4 inches, and the largest having a capacity of 12x17 inches.

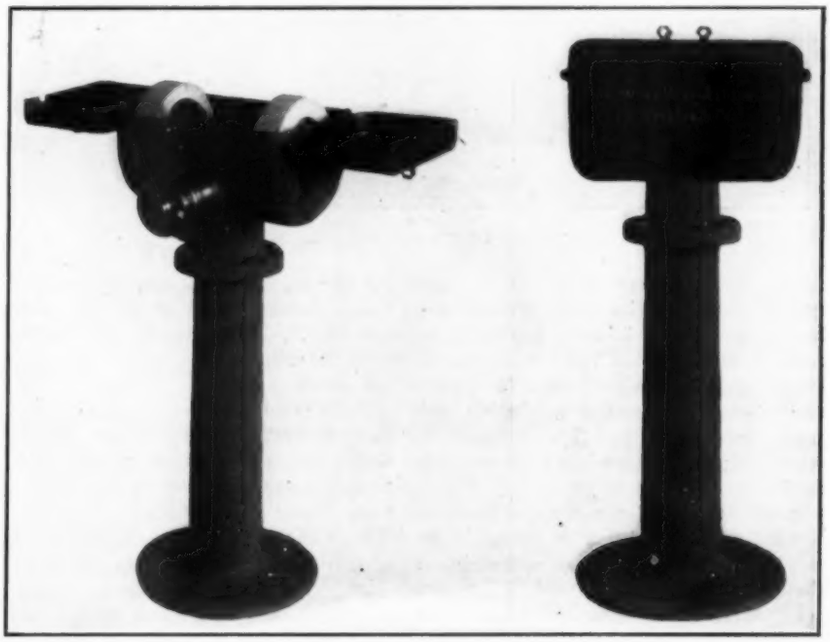
Revolving Oilstone Grinder

This tool is designed principally for use in pattern and other woodworking shops where it is necessary to have tools with a keen edge.

In appearance it resembles an emery grinder, but has oilstone wheels mounted instead. In the new design shown, there is a provision at the back for a small round-face emery wheel for grinding gouges when necessary.

The wheel arbor is driven by spiral gearing, permitting the tight and loose pulleys to be put at the back of the grinder and keeping the driving belt out of the way.

These machines are used in two ways: either running in a bath of kerosene, which keeps the surface free from glazing and prevents heating; or without the bath, at about twice the speed. In this case the wheels are saturated with kerosene, which sinks in very readily, but is brought to the surface by centrifugal force when the wheels are revolved. After being once saturated they only need a few drops of oil occasionally to keep then in good condition. Equally good results are said to be obtained in either case, and the latter



REVOLVING OILSTONE GRINDING MACHINE

The latest type of this tool is entirely self-contained, having an electric motor mounted under the bed, as shown. This motor is one-quarter horse-power, is wound for either direct or alternating current and enables the machine to be set in any position or moved to any point where current is available.

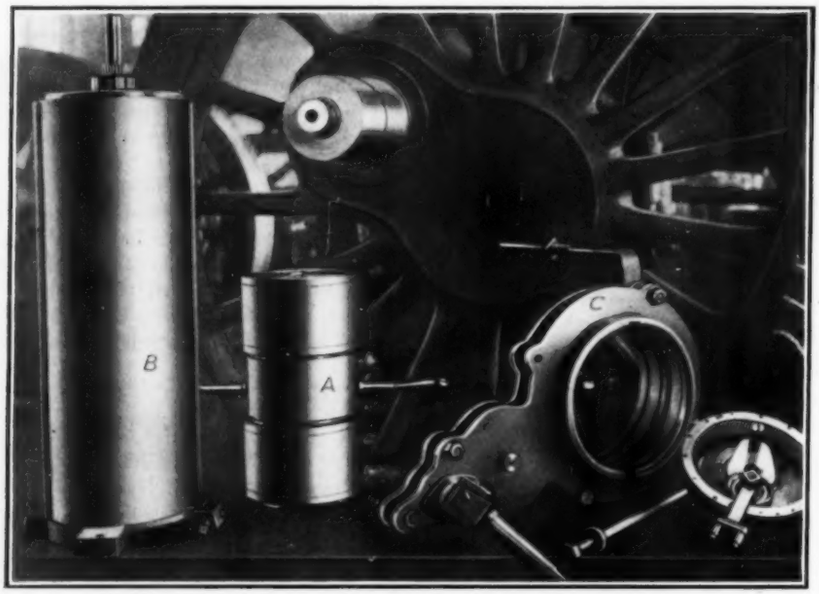
method has the advantage of being faster.

The lids act as oil trays and catch any oil that runs down the tool, returning it to the case when the lids are closed. They also keep the dust away from the wheels when not in use.

Tools oilstoned on these wheels are all ready for use, and much time can be saved over oil-stoning by hand. They are made by the Mummert, Wolf & Dixon Company, Hanover, Pennsylvania.

A Portable Crank-pin Turning Machine

Inasmuch as the outside end of a locomotive crank pin, from which projects the gudgeon screw, never becomes altered in shape from wear, it follows that if a machine of a suitable character be attached to the screw, and facing truly



A PORTABLE CRANK-PIN TURNING MACHINE

against the end just referred to, the surface of the crank pin, which through use has become altered in form, can easily be restored to its original shape and quarter.

The accompanying photograph shows such a machine attached to the pin and ready for operation. The manner in which this machine performs the work is as follows:

After screwing the machine *A* firmly to the end of the crank pin by means of the two handles, the latter are removed and the sliding sleeve *B* is placed on the barrel. Attached to this sleeve are four lugs, containing the necessary tools for roughing, finishing, and filleting the crank pin. The tools are of 5/8-inch round high-speed steel. The gear wheel and casing *C* are then slipped over the two feather keys, when by means of an air motor the sleeve is caused to revolve around the crank pin.

The forward or feeding motion of the sleeve is accomplished through mechanism contained in a hand wheel, which feeding is either automatic, or by hand, according as the gearing is engaged or disengaged. It is not necessary to stop the motor to throw the feed in or out. Provision has been made for any lost motion from ordinary wear and tear of the barrel and sleeve, by adjustable rings, which are screwed against taper split bushings on each end.

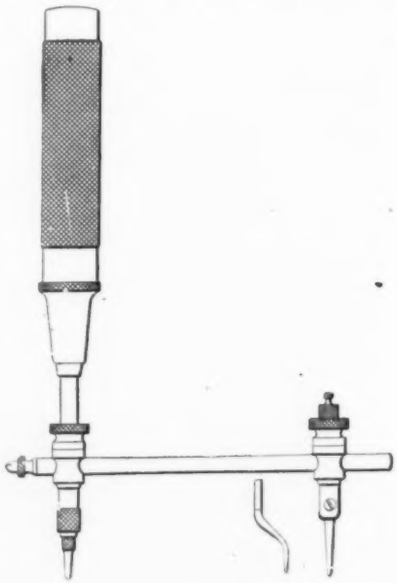
The machine consists of four parts, no one of which is too heavy to be handled by even a boy. This crank-pin turner can be adjusted to any pin having a threaded end by simply making a face plate to suit the pin, and threading it to fit the extension.

The largest locomotive crank pin can be re-turned to shape in three hours. A great saving of time is thus affected, as compared with the practice generally in vogue of removing and turning or of filing the pin. It can be used in any roundhouse without removing the wheels from the engine, and is successfully operated with 70 pounds air pressure through an air motor.

As a result of several years' observation, it has been ascertained that providing the main pins are maintained in a "true" condition, those in the front and back wheels require little or no attention. The number of rod breakages will materially be lessened, and the brasses will give a far greater mileage. Several of these machines are in use by the Grand Trunk Railway Company, having displaced various other makes.

Spacing Attachment for Automatic Center Punch

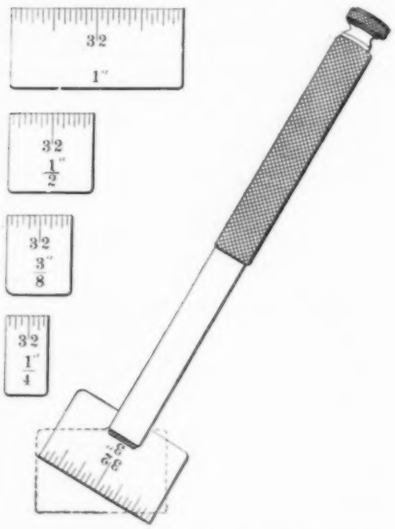
The illustration shows an attachment the Brown & Sharpe Manufacturing Company, of Providence, R. I., has recently designed for use in connection with their automatic center punch, the arrangement being useful for spacing and laying out work to be machined or drilled. When adjusted, the attachment is screwed on to the center punch in place of the removable point. Fine adjustment of the locating point is obtained by means of the screw at the end of the beam and quick adjustment by pulling out the knob at the top of the post. The point is held by a nurled check nut and can be adjusted to the desired length.



SPACING ATTACHMENT FOR AUTOMATIC CENTER PUNCH

Steel Rules with Holder

The rules and holder shown herewith are convenient where the ordinary rule cannot be used, as in measuring a recess or keyway, as well as in tool and die work. The holder takes any of the five sizes of rules. The barrel is nurled for a finger



STEEL RULES WITH HOLDER

grip. The rules are held in a split chuck, adjusted by a nurled nut at the top of the barrel, and can be set at various angles, according to the work. The rules are of tempered steel, graduated 32ds on one side and 64ths on the other, or 50ths on one side and 100ths on the other. The Brown & Sharpe Manufacturing Company, Providence, R. I., is the maker.

Personal

Henry Weller, formerly of Batavia, Rochester and New York, is requested to send his address to the editor.

G. P. Blackiston has resigned from the Crucible Steel Company of America to take a more active interest as president and general manager of the Pittsburgh Automatic Vise and Tool Company, of Pittsburg, Penn. This company is the manufacturer of the well known "Pittsburg" double- and single-swivel vise, and its growth of business has been quite extensive, not only in the domestic trade, but throughout the large markets of the world.

The Japanese government has issued a proclamation extending the guild system, and giving industrial companies the right to borrow freely of state funds at low rates of interest This action is construed as a step toward federal control and ownership of the industries so generously fostered. That monopoly by the government of various manufacturing enterprises is the aim of Japan is evident, in view of recent developments in that country. Salt, tobacco and camphor have already passed into government control, and railroads are on the way thither. The proclamation just issued will be sure to strengthen Japanese nationalistic competition against American and European trade, and to confirm the protective subsidizing policy. The number of Japanese guilds, which Minister of Agriculture and Commerce Matsuoka is seeking to increase, has risen in the past six years from 30 to 700.

Business Items

The Lunkenheimer Company, Cincinnati, Ohio, has established its eastern office and warehouse at 66-68 Fulton street, New York. Alfred J. Kupp managing this division of the company's business.

The Cambria Steel Company, Johnstown, Penn., would like to receive the latest catalogs from manufacturers of machinery and supplies for general steel works equipment. All catalogs should be addressed, care chief engineer.

F. H. Brown Machinery Company has opened an office in the Park building, Pittsburg, Penn., where they will represent a number of machine tool manufacturers, making a specialty of buying and selling second-hand machinery. Among other products a complete line of Bradford lathes is announced.

The Crocker-Wheeler Company, Ampere, N. J., has recently opened an office in Birmingham, Ala., in order to handle the rapidly increasing business in that section. They have just received an order from the Tennessee Coal and Iron Company, for the complete electric motor equipment of its new steel rail mill at Birmingham.

The Abner Doble Company, engineers, of San Francisco, has appointed Mitui & Company, to act as its sole agents in Japan and its territories, Korea, China and Manchuria, for the sale of Doble Tangential water wheels and hydraulic apparatus. Mitsui & Company is a large and progressive engineering house in the Far East with thirty-five branch offices.

Trade Catalogs

Lanston Monotype Machine Co., Philadelphia, Pa. Catalog containing detail plates of the Monotype casting machine.

Wagner Electric Co., St. Louis, Mo. Bulletin No. 76, illustrating and describing single-phase variable speed ventilating outfits.

Challenge Machine Co., Philadelphia, Pa. Booklet No. 20, describing grinding machinery. Illustrated, 20 pages, 3½x6 inches, paper.

The Barrett Electric Mfg. Co., Cincinnati, O. Bulletin No. 5, describing Type E motors and generators. Illustrated, 19 pages, 7½x10 inches.

Ferracute Machine Co., Bridgeton, N. J. Temporary Catalog No. 15, describing foot and power presses. Illustrated, 38 pages, 4½ x6 inches, paper.

Rockville Machine Co., Rockville, Conn. Catalog of Hercules iron cutter and shear, Hercules metal punch. Illustrated, 11 pages, 3½x6 inches, paper.

Fishkill Landing Machine Co., Fishkill-on-the-Hudson, N. Y. Catalog describing Fishkill Corliss engine. Illustrated, 40 pages, 6½x10 inches, paper.

Minneapolis Steel & Machinery Co., Minneapolis, Minn. Brochure No. 101, describing Twin City Corliss engine. Illustrated, 32 pages, 6x9 inches, paper.

Foote Bros. Gear and Machine Co., 24-30 South Clinton street, Chicago, Ill. Catalog of gears and special machinery. Illustrated, 110 pages, 4½x6½ inches, paper.

Ph. Bonvillain & E. Ronceray, Paris, and 1315 Race street, Philadelphia, Pa. Catalog (in English) describing universal system of machine molding. Illustrated, 96 pages, 6x9 inches, paper.

The Rotary File & Machine Co., 589 Kent avenue, Brooklyn, N. Y. Booklet telling something about band-saw machines, sharpeners, setters, blades, guides and brazers. Illustrated, 3½x6 inches.

Manufacturers

The Lonsdale (Tenn.) Foundry Company is enlarging its plant.

The Lobdell Car Wheel Company, Wilmington, Del., will erect an addition.

The Waterloo (Iowa) Gasoline Engine Company is erecting a new foundry.

The Ingersoll Milling Machine Company, Rockford, Ill., will enlarge its plant.

The Cedar Falls (Iowa) Scale and Manufacturing Company will erect a factory.

The Henry Taylor Lumber Company, Danville, Ill., will erect a large planing mill.

The Cincinnati (Ohio) Shaper Company will build a one-story addition to its plant.

The Ashley-Price Lumber Company, Douglas, Ga., will rebuild sawmill recently burned.

The Jasper (Ala.) Machine and Engine Company, a new concern, is erecting machine shops.

The Wilson Stove and Manufacturing Company, Anniston, Ala., will install new machinery.

Gade Brothers Manufacturing Company, Cedar Rapids, Iowa, may erect a foundry building.

The Lieber Cypress Company, Arkansas City, Ark., will soon erect a new saw and shingle mill.

The Maryland Electric Railways Company, Baltimore, Md., will erect a new power house to cost $12,000.

The Houston (Texas) Gas Company will make improvements which will represent an outlay of $250,000.

The Brookford Cotton Mills, Brookford, N. C., will replace some of its old equipment with new machinery.

The Dixon Car Wheel Company, Houston, Texas, is erecting a group of new buildings for foundry purposes.

The plant of the Monarch Motor Car Company at Franklin Park, Ill., recently burned, will be rebuilt at once.

The Citizens Railway and Light Company, Muscatine, Iowa, will make extensive improvements to its gas plant.

The Sunflower (Ala.) Lumber Company, lately incorporated, will erect and equip building at a cost of $15,000.

The Helena (Ark.) Woodenware Company, recently incorporated, will erect a plant to cost about $50,000 with equipment.

The iron foundry of the Kingsland-Kay-Cook Manufacturing Company, St. Louis, Mo., was destroyed by fire. Loss, $30,000.

W. J. Oliver & Co., Knoxville, Tenn., it is reported, will expend about $100,000 in the construction of another machine shop.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper catalog free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

We desire a few more machines or specialties to manufacture. Address Box 423, Troy, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Contract machine work, tools and dies to order. Northwestern Machine Co., Detroit, Michigan.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Table of plunger loads, compound and triple expansion direct acting pumps. 25c. F. F. Nickel, 150 Nassau St., New York.

Wanted — Foreman mechanic to help me buy stock of a Pittsburg machine shop doing jobbing and light manufacturing business. Address B. F. Bain, Pittsburg, Pa.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted — A responsible concern to place on the market a material for case hardening which revolutionizes present methods. Address "Inventor," AMERICAN MACHINIST.

Arrange with us to do your manufacturing; we build special machinery, special tools, etc. Lewis Blind Stitch Machine Company, 502 North Commercial St., St. Louis, Mo.

If Henry Weller, formerly of Batavia, Rochester and New York, will send his address to John Henry Blake, care Thomas Cook & Son, Paris, France, he will learn something to his advantage.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Foundry corporation having large contract for automobile cylinders, pistons, etc., desires to connect with progressive machine shop equipped to do necessary machining; no assembling. New England, care AMER. MACH.

New Process; U. S. A. patent for sale; important machine adopted by British and foreign governments, carrying out new process and selling at $500; the machine and its product have large and profitable sale among tool users. Box 941, AMERICAN MACHINIST.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers. 146 West 56th street.

Advice; mechanical, practical and technical; tell me your needs. I'll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y., U. S. A.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

As assistant superintendent or assistant chief draftsman; twelve years' technical and practical experience; reliable. Box 988, AMERICAN MACHINIST.

By a thorough up-to-date mechanic, position as machine shop foreman or superintendent; good executive ability; wide experience in building machinery and tools; best of references. Address Box 992, AM. MACH.

ILLINOIS

Foundry and machine works superintendent, broadly qualified; 35 years' practical and technical experience; proved executive and business ability; seeks responsible position in small or medium sized city; ample references; salary an object. Address "Widower," AMERICAN MACHINIST.

MASSACHUSETTS

Mechanical superintendent; age 36; now employed; experienced in interchangeable manufacture; practical; systematic; successful shop organizer and manager of men. Box 5, AMERICAN MACHINIST.

MICHIGAN

Wanted—Position as machine tool and machinery salesman by a practical shop man, expert machinist and toolmaker; 32 years of age, considerable traveling experience; business getting salesmanship guaranteed; east of Buffalo; A-1 references as to ability, integrity, honesty, etc. Address "J. I. J. P.," care AMERICAN MACHINIST.

NEW JERSEY

Draftsman, mechanical, 27, wishes position; 5 years shop, 2 years drawing. Box 986, AMERICAN MACHINIST.

Draftsman and machine designer with long experience in shop and drafting room is open for engagement. Box 9, AMER. MACHINIST.

Instructor in trade school work desires change; now employed in that capacity in one of the foremost institutions of its kind. Box 994, AMERICAN MACHIN ST.

Mechanical draftsman, German, technical graduate, experienced in general engineering and construction work, etc., desires to change. Box 985, AMERICAN MACHINIST.

Superintendent now employed desires change; experienced in agricultural implement manufacture; now holds position of large responsibility. Box 993, AMER. MACH.

Master mechanic or foreman open for engagement; excellent toolmaker and designer of labor-saving devices; strong executive and good manager of help; A1 references. Box 977, AMERICAN MACHINIST.

Wanted—Position as factory manager or superintendent by one thoroughly familiar with the design and manufacture of gas, gasolene and producer gas engines and producers; capable of producing the best results. Address "Reliable," AMERICAN MACHINIST.

NEW YORK

Draftsman, familiar with automatic machinery and various classes of work, wishes position. Box 6, AMERICAN MACHINIST.

Superintendent; mechanical and technical training; 7 years' executive experience, desires position with live interests. Box 958, AMERICAN MACHINIST.

Superintendent of well-known concern desires change; good mechanic and executive; has made others and can make your plant pay. Box 917, AMERICAN MACHINIST.

Designing draftsman for tool machinery, dies, fixtures and jigs, desires position; 15 years' experience; best reference; West or East. Box 987, AMERICAN MACHINIST.

Practical mechanic—technical and business training, with initiative and capacity, 17 years' executive experience—wants position as factory superintendent Box 924, AM. M.

Situation as foreman for automatic screw machine department using Brown & Sharpe machines; 13 years' experience; small town preferred. Box 10, AMERICAN MACHINIST.

Experienced drop-forge man to design dies and take charge of plant; 20 years shop experience, 5 years in charge; East preferred; best of references. Box 979, AM. M.

Position as superintendent or general foreman; experienced on jigs, fixtures, dies, gages, sheet metal and interchangeable work; at present employed; age 34; references given. Address Box 996, AMERICAN MACHINIST.

Manager, thorough practical and general education, also commercial and 2 years' executive experience as assistant manager, wants position where making the business grow both economical in producing and greater number of sales are considered. Box 7, AMERICAN MACHINIST.

PENNSYLVANIA

Machine shop foreman desires change; good reference. Box 4, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Wanted—Draftsman; first-class man with experience in general engineering and construction work; applicants must state age, qualifications, references and salary. Solar Observatory Office, Pasadena, Cal.

Gisholt lathe operator; a well known Pacific coast firm desires communication with an operator of Gisholt lathes with a view of permanently retaining him; married man preferred; highest wages paid. Address Box 982, AMERICAN MACHINIST.

CANADA

A competent traveler in heating and ventilating wanted; give references. Dominion Heating and Ventilating Co., Hespeler, Ont.

CONNECTICUT

Wanted — First-class all-round machinist for new and general repair work. The New Machine Co., Danbury, Conn.

Wanted — Machine designer familiar with rolling mill machinery; rapid and accurate; permanent position; state age, experience, reference and salary required. Box 964, AMERICAN MACHINIST.

ILLINOIS

Wanted—Experienced chief engineer for electric power plant of 25,000 kw. capacity, operating compound reciprocating engines, steam turbines and gas engines; a permanent and well paid position for competent, responsible man; give detail of experience, present position and salary. E-20 Room 1300, Trude Bldg., Chicago, Ill.

Wanted—By an established firm, making high-grade automatic machinery, a designer experienced on automatic punch press and die work for small parts similar to watch work; position permanent; in replying, state age, nationality, married or single, and salary expected; also experience and references; correspondence considered confidential and will be returned if desired. Box 3, AMER. MACH.

INDIANA

Wanted—Fifteen lathe men and assemblers; new shop, good wages, steady employment. The Western Motor Company, Logansport, Ind.

Wanted—A working foreman; must be a practical die maker and familiar with stamping metal specialties; must have executive ability; be sober and able to furnish the best of reference; state age, if married or single, and salary wanted. Address Bernardin Bottle Cap Co., Evansville, Ind.

MASSACHUSETTS

Wanted—One experienced screw machine hand, one general gear cutting man; skilled inspector for machine parts; good working foreman on turret machines. Boston Gear Works, Norfolk Downs, Mass.

Mechanical superintendent for a gear cutting machine shop doing contract work on small and large orders, employing about 75 to 100 men; must be thoroughly capable mechanic; must have originality, and several years' experience in handling men; all applications in writing, stating age, giving references as to ability and character; all communications confidential. Boston Gear Works, Norfolk Downs, Mass.

Superintendent, by growing company building high-grade grinding machinery and employing about 100 hands; must be thoroughly up-to-date in methods; successful in handling men, and able to produce first-class work at reasonable cost; other things equal, preference will be given man with experience on first-class machine tools; write fully as to experience, age, salary expected and present position; confidential if desired. Box 2, AMERICAN MACHINIST.

Wanted—A young man to assist superintendent as shop foreman in a shop employing 150 men manufacturing small tools; must be familiar with manufacturing small tools and capable of handling men and getting out work; we have a desirable position for a competent man; references must be of the best; in answering give age, experience and about what salary would be expected; factory in Massachusetts; answers to this ad will be held strictly confidential. Box 990, AMERICAN MACHINIST.

MICHIGAN

We have a first-class position open for a mechanical draftsman and engineer, who is familiar with duplex pump designing and shop practice. Box 991, AMER. MACHINIST.

Wanted—By an established Michigan gasolene engine manufacturer, an experienced draftsman and designer to take full charge of drafting department; applicant must be up to date in factory details and a hustler, to such a permanent position is offered; state age, married or single, reference and salary expected; communications treated confidentially. Box 915, AMER. MACHINIST.

Mechanical superintendent for machine shop doing contract work on small parts and employing two hundred men; must be a thoroughly capable mechanic and have had several years' experience in handling the men; must be able to design jigs and tools for rapid production of duplicate work and able to give references as to ability and character; all communications confidential. Box 949, AMERICAN MACHINIST.

MISSOURI

Draftsman wanted — Large lead mining company, 65 miles south of St. Louis, Missouri, wants draftsman for mechanical drafting and for making surface and underground maps; must be first-class freehand letterer and neat workman; man with knowledge of plotting and calculating survey field notes preferred; applicants please submit specimens of work and state salary wanted. Box 867, AMERICAN MACHINIST.

NEW JERSEY

Wanted—First-class mechanical draftsman on tools, jigs and shop fixtures, located 35 minutes from New York City. Box 962, AMERICAN MACHINIST.

Wanted at once, in New Jersey, near New York, competent mechanical draftsmen on electrical machinery; state salary and experience. Box 980, AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

NEW YORK

Several good planer hands on wood-working machinery castings. Box 969, AMER. MACH.

Wanted—Good mechanical draftsman; man with experience on valves preferred; apply stating age, experience and salary expected to Box 999, AMERICAN MACHINIST.

Wanted—Manager of a prosperous machine plant established in 1855; man preferred who will take some financial interest in the business; exceptional opportunity for the right man; give experience. Address "Profitable Opportunity," Box 981, AMER. MACHINIST.

Wanted—Foreman for screw machine department; Brown & Sharpe hand machines and automatic machines No. 2 and 00; must be thoroughly competent, up to date and familiar with small accurate work; state wages and references. "Y. Z.," Box 983, AM. M.

Wanted—Draftsman experienced on instrument work and small automatic machinery;

must be quick to conceive idea and capable of working it out mechanically; salary $25 per week; answer stating experience and references. "J. K.," Box 984, AMER. MACHINIST.

NORTH CAROLINA

Wanted—First-class all-around machinist for job shop; must be sober and quick. Carolina Machine Co., Fayetteville, N. C.

OHIO

Wanted—Good mechanic for erecting electric cranes. Apply, giving experience, Case Mfg. Company, Columbus, Ohio.

Wanted—In middle west, first-class machinists on floor and vise machines; no labor troubles; steady employment at good wages. Box 1, AMERICAN MACHINIST.

Wanted—An all-around machinist to instruct apprentices and handymen on machine tools; good salary; permanent employment and no labor troubles. Address Box 989, AMERICAN MACHINIST.

Head draftsman for a Cincinnati machine tool shop of 100 hands; one with experience on radials and turret machinery preferred; state experience and salary. Address Box 913, AMERICAN MACHINIST.

Valve and steam goods designer wanted by a concern in the Middle West manufacturing valves and steam accessories, a young man capable of taking up the details of designing and manufacturng; one with technical knowledge preferred. Write stating age, experience, references and salary required, Box 997, AMERICAN MACHINIST.

PENNSYLVANIA

Hammer men for steam or board drop. Cambria Forge Company, Johnstown, Pa.

Wanted—Competent pattern maker; one familiar with cabinet making preferred. Box 995, AMERICAN MACHINIST.

Wanted—Machinists, fitters and machine hands; desirable class of machine tool work. Colburn Machine Tool Co., Franklin, Pa.

Wanted—Blacksmith, experienced on machine shop work, forging, case-hardening and fine tempering. Demorest Mfg. Co., Williamsport, Pa.

On account of increase of plant, we want molders, lathe, planer and floor hands; good pay and steady work to good men. Address or apply Ridgway Machine Company, Ridgway, Pa.

Wanted—Foreman, skilled machinist for small shop building machinery; man who will take interest, finest opportunity for good man. Address giving full particulars, P. O. Box 1405, Pittsburg.

Wanted—Experienced mechanical and electrical draftsmen on electrical machines and apparatus; only first-class men need apply; state experience and salary expected. Address Box 978, AMERICAN MACHINIST.

Wanted—Machine shop foreman for plant employing about 40 hands manufacturing engine lathes and special machinery; must be a first-class man and come well recommended; state salary wanted. Address Box 968, AMERICAN MACHINIST.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket, R. I.

WEST VIRGINIA

Wanted—A machinist familiar with repair work on blanking presses and dies. Address "W," AMERICAN MACHINIST.

Wanted—First-class toolmakers for small jig and die work; also machinists accustomed to small work. Apply by letter or personally, American Telegraphone Co., 57 18th street, Wheeling, W. Va.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

FOREIGN

First-class foreman wanted over department of works building power presses; one with American experience preferred; must work to jigs, and be well up in all latest shop practice; state age, wages, experience. J. Rhodes & Sons Ltd., Wakefield, England.

For Sale

Machine shop for sale; see top of page 58.

Test Indicators. H. A. Lowe, Cleveland, O.

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

One universal drafting machine 18"x24" in perfect condition, $18. D. J. Kelsey, 515 Y. M. C. A., New Haven, Conn.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, Ohio.

For Sale—Foundry and machine shop in central New York; established trade and bright prospects; only $2500 down to proper party; owner retiring. Box 8, AMER. MACH.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

For Sale—All or part interest in a small tool machine business in Western Pennsylvania, now running 15 hands, manufacturing a patented adjustable reamer; more capital required to take care of increasing business. Address "L," 547 Arch St., Meadville, Pa.

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A New Railway Car Dynamometer—I

The 100,000-pound Dynamometer Car of the Pennsylvania Railroad, Its Recording Mechanism and the Record It Produces

BY A. H. EMERY, JR.

The problem of determining and making a record of what the reciprocating engine, either stationary or locomotive, is capable of doing, has interested engineers for many years.

The most natural way to start is to be accomplished by the use of brakes or of a transmission dynamometer; but in the case of a locomotive the situation becomes more complicated.

The most natural way to start is to make the locomotive into a stationary engine for the time being by supporting its drivers on wheels with supported axles, and applying the brakes to these axles in such a manner that they absorb and at the same time measure the output of the locomotive. It is, of course, necessary to fasten the drawbar to some stationary support to take the pull and keep the axles of the drivers exactly, or very nearly, over the supporting wheels. Then, by measuring the indicator horse-power and the brake horse-power, and making the necessary corrections for friction of the bearings of the supporting axles, the

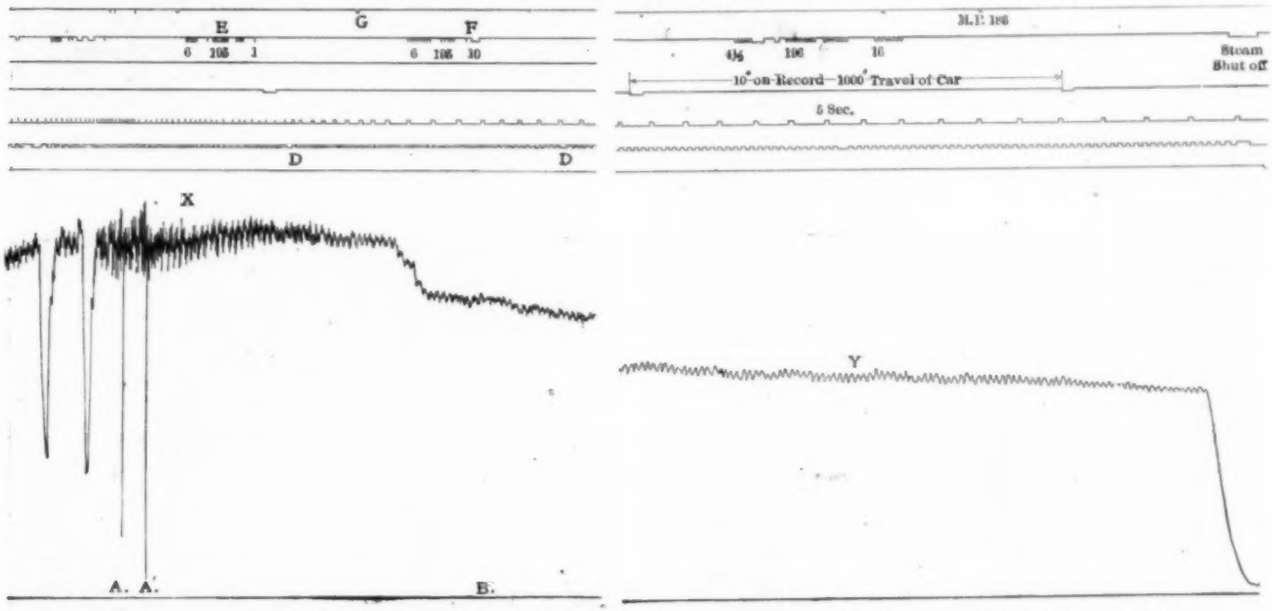


FIG. 1. RECORD MADE BY HEAVY FREIGHT LOCOMOTIVE 1 INCH IN HIGHT OF CURVE—5000 POUNDS DRAWBAR PULL

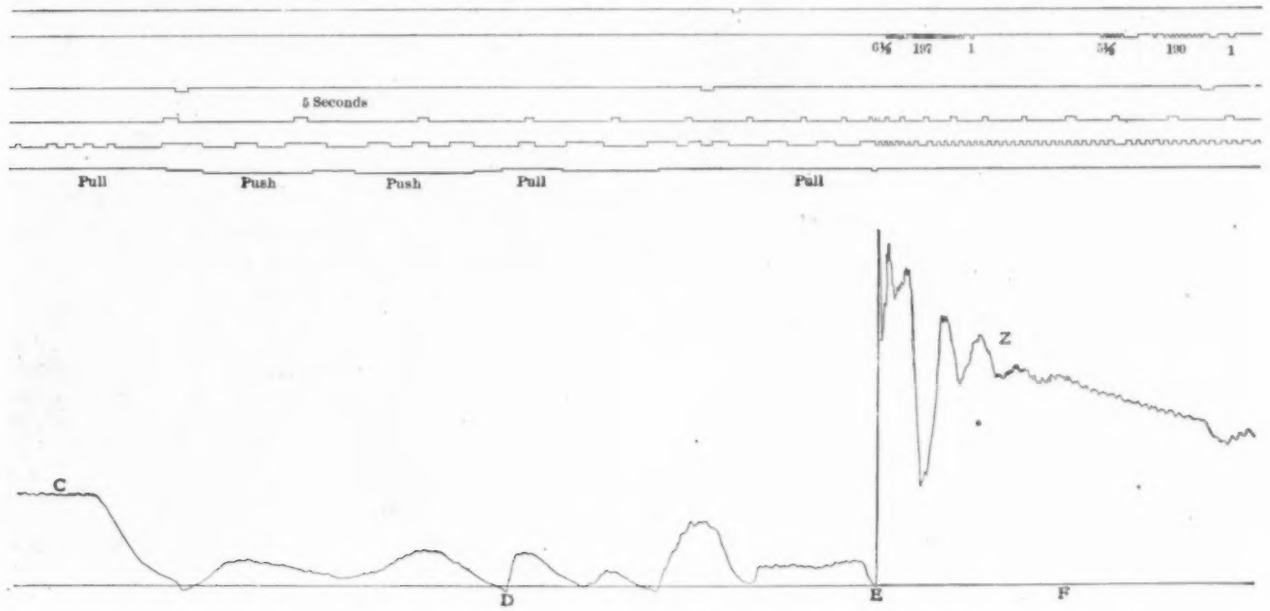


FIG. 2. RECORD MADE IN STOPPING AND STARTING A TEN-CAR PASSENGER TRAIN 1 INCH IN HIGHT OF CURVE—5000 POUNDS DRAWBAR PULL

efficiency of the locomotive can be obtained under any desired set of conditions.

The next step is obvious and is to measure the pull or push on the drawbar, thus measuring the amount of force which the locomotive can exert on the train.

Various testing plants have been built on this principle, either with or without the dynamometer for weighing the drawbar pull. A description of several of these, by Prof. W. F. M. Goss, will be found in the reports of the Chicago meeting of the American Society of Mechanical Engineers, in May and June, 1904.

The latest plant of the kind mentioned is the one built by the Pennsylvania Railroad Company, exhibited at the St. Louis Exposition, and now permanently installed at Altoona, Penn. The dynamometer, or apparatus for weighing the drawbar load, was built by William Sellers & Co., Inc., Philadelphia, Penn. This plant has already been described in the December 15, 1904, issue of the AMERICAN MACHINIST.

With a plant of this kind, interesting, valuable and exhaustive tests can be made on the locomotive, but nothing can be determined in regard to the load necessary to haul trains of various lengths and weights over various grades or curves, of the difference in efficiency of a locomotive used alone or in tandem, or used as a "pusher." For this class of tests it is necessary to have an instrument which can weigh and make a record of the pull or push between the locomotive and train, and it is such an instrument that the writer wishes to describe.

In 1886, or thereabouts, the Pennsylvania Railroad ordered such a dynamometer of the Yale & Towne Manufacturing Company, of Stamford, Conn. It was designed by Albert H. Emery and calibrated by him and A. S. Vogt, mechanical engineer of the Pennsylvania Railroad. The instrument was placed in a suitable car by the Pennsylvania Railroad engineers, who also designed and built the mechanism for driving the paper on which the record was made and the instruments for recording the speed of the train, etc. This dynamometer had a maximum capacity of 28,000 pounds, and the recording pen had a maximum movement of 7 inches above the base line. The value of 1 inch of movement was therefore 4000 pounds, and was constant under all conditions. Many

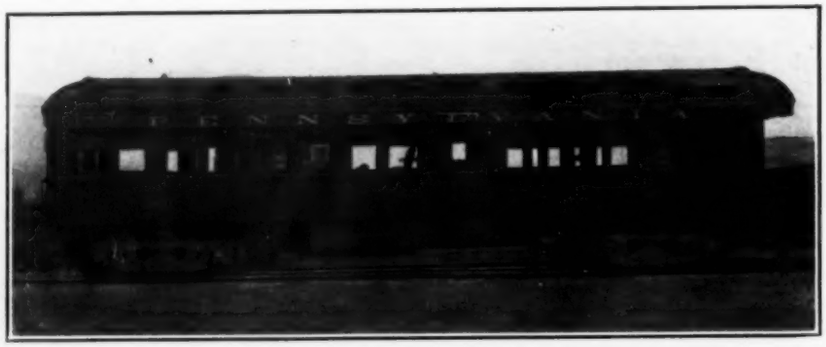


FIG. 3. THE DYNAMOMETER CAR

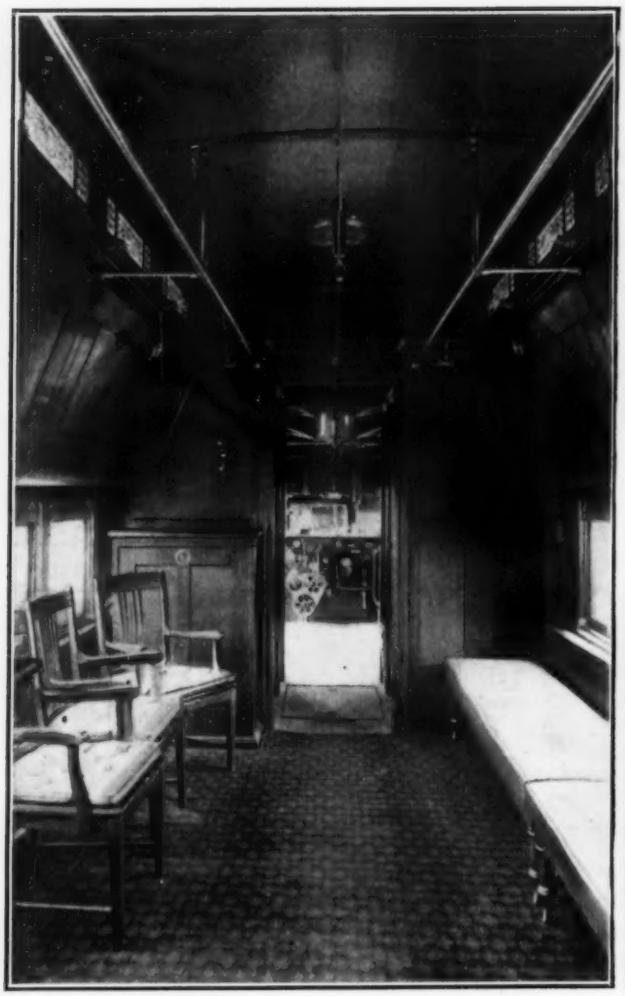


FIG. 4. GENERAL VIEW THROUGH CAR

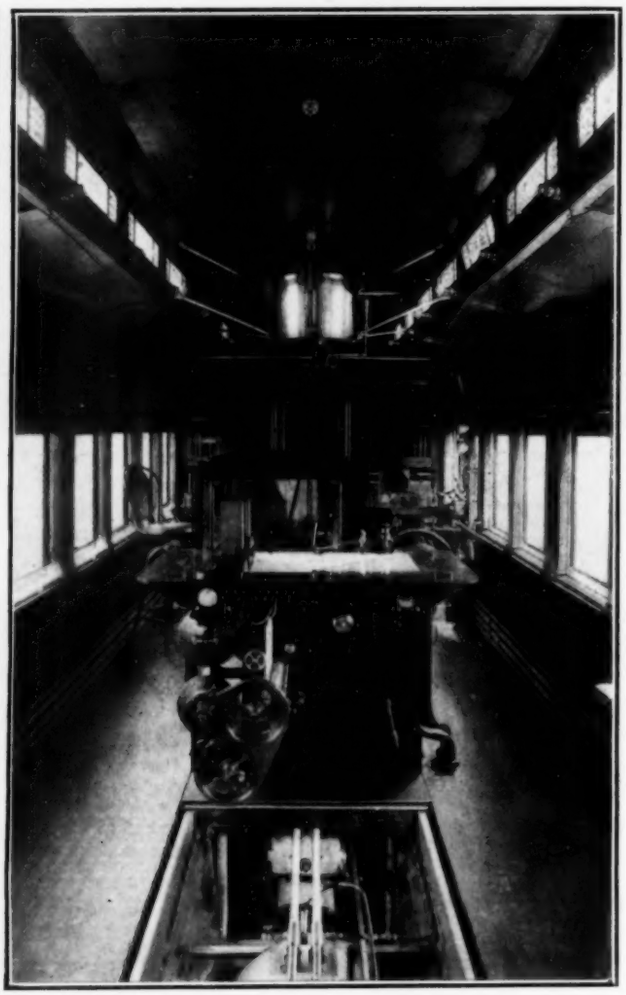


FIG. 5. WORK ROOM FROM CENTER OF CAR

tests were made with this car, and a great deal of valuable information obtained, but it gradually became inadequate to the demands upon it, as can readily be seen from one fact alone, that a modern, heavy freight locomotive can pull over 40,000 pounds, or 50 per cent. more than the maximum capacity of the dynamometer. The need for a machine of larger capacity increased as the number of large locomotives and heavy trains increased, and finally a contract was made by the Pennsylvania Railroad Company with Mr. Emery to design and build another dynamometer, to have a maximum capacity of 100,000 pounds and a maximum movement of the recording pen of 10 inches; the motion to be in the same direction from the base line for either push or pull, and the apparatus to be adjustable so that the value of 1 inch of motion of the pen could be made to be either 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000 or 10,000 pounds. The railroad engineers were to design and build the car, the paper-drive mechanism, and such other apparatus as they desired for additional records. This dynamometer was built and calibrated by Mr. Emery, most of the work being done at the Bridgeport works of the American and British Manufacturing Company, while the car, instruments, etc., were designed in the office of the mechanical engineer of the Pennsylvania Railroad, A. S. Vogt, at Altoona, Penn., and built in the Juniata shops.

In order to interpret correctly and easily the meaning of the record made by the dynamometer, several other records are necessary or desirable.

The paper on which all of these records are made is 18 inches wide, is driven by gearing from one of the axles, and moves under the pens at a rate of 52.8 inches per mile travel of car. Near one edge of the paper there is a pen to rule a zero or base line, above which the pen of the dynamometer makes its record. Besides these two, there are eight electrically operated pens, making the following records:

(1) Which shows whether the load is push or pull.

(2) Which records the integration of the area between the dynamometer record and the base line, or a line parallel thereto.

(3) Which makes a time record every one, two, or more seconds, as may be desired.

(4) Which records the distance traveled by the car.

(5 and 6) Which are operated from the engine and are used to show when indicator cards are taken, and to note the boiler pressure and the position of the throttle and reverse lever, by a suitable code.

(7) Which is operated by an observer at one of the windows and used for locating mile posts, etc.

(8) An "extra" to be used in any way desired.

All the recording pens are in a straight line across the paper.

The Record

In Fig. 1 are shown portions of a record taken on one of the test runs. This record was made with a very heavy freight engine in first-class condition pulling a train of 52 loaded cars, each of 100,000 pounds' capacity, but carrying about 20 per cent. overload, so that the total weight of the train, including the dynamometer car, was 7,600,000 pounds. At the point where this record was taken, the engine was on an up grade and had been obliged to slow down for a block signal, and was thus taxed to its utmost to get the train over the crest of the grade. At the left of the record the average pull is increasing and the speed diminishing, while at two places the sand stopped running and the driver slipped,

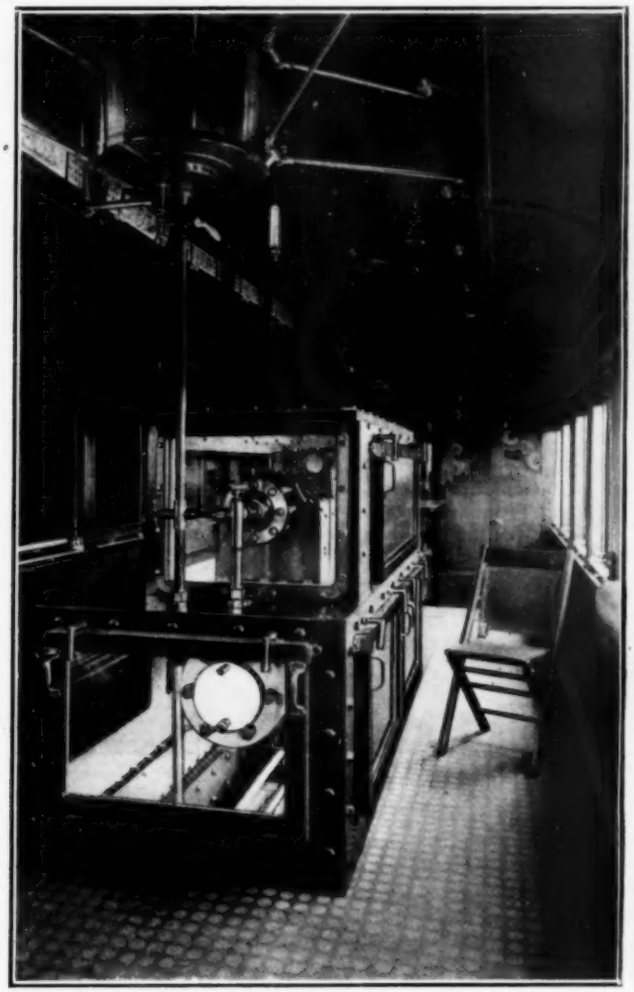


FIG. 6. THE WORK ROOM

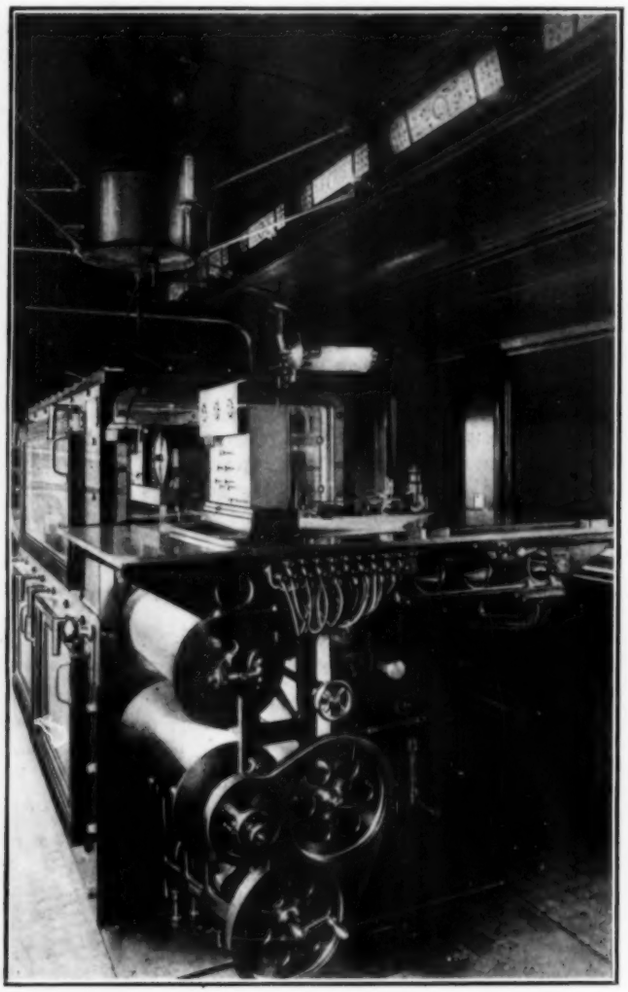


FIG. 7. THE PAPER DRIVE AND TABLE

causing the pull to drop down very decidedly. At *A* the engineer shut off steam and the load changed to push momentarily, as is shown by the jog in the first line above the dynamometer record; but, as there is a throttling valve in the system, which is equivalent to a dash-pot, the pen did not have time to get to zero before the action of the brakes caused the load to become pull again. An attempt was then made to start the train with the reverse lever down in the corner, but again the wheels slipped and the train stalled. A second attempt, however, was successful, and the train pulled over the crest of the grade, the speed increasing but the average pull keeping about uniform, until at *B* the reverse lever was hooked up to the tenth notch, and the pull at once decreased. The value of an inch of ordinate on this run was 5000 pounds, and as the maximum ordinate just before the train stalled at *A* is 9.375 inches, the pull was 46,875 pounds, and the average pull for the next 550 feet of travel of the train was 43,000 pounds.

The second record above the dynamometer curve is made by a pen operated from a mechanical integrator, and every notch has a value of one square inch of area between the dynamometer record and a base line. As the value of an inch of ordinate in this case is 5000 pounds, and as one inch movement of the paper equals 100 feet travel of the train, each notch has a value of 500,000 foot pounds of work. Every fiftieth notch is skipped, as at *D*, so that they can be rapidly added up to get the total work recorded between any two points on the record. If the base line for the integrator and for the dynamometer record coincide, then the integrator record gives the amount of work done by the engine; but as the integrator works more accurately if its base line is below that of the dynamometer, there will usually have to be a correction made, which depends only upon the original setting of the integrator and the distance traveled by the train, and is independent of the hight of the ordinate of the dynamometer record.

The next record is made every five seconds, and it is easily seen that the number of the notches per inch is a measure of the speed of the train. As the motion of the paper under the pen is at all times exactly proportional to the motion of the car, a scale can readily be graduated to read in miles per hour. As one hour equals 3600 seconds, it contains 720 five-second intervals. As 52.8 inches motion of the paper equals one mile travel of the car, if the speed were a mile per hour the notches would be 0.0733 inches apart; if it equaled two miles per hour, they would be 0.1466 apart, etc.

The next record line has a notch in it every time the paper travels 10 inches or the car travels 1000 feet, and this gives a quick method of measuring the distance the car has traveled between any two points on the record.

The next record pen was not used on this run, but is used when indicator cards are being taken on the engine, and it makes a notch in the record line whenever a card is taken.

The sixth record is made by a telegraph key in the engine cab, and shows in this case the number of notches opening of the throttle, the boiler pressure, and the reverse-lever notch; as at *E*, the throttle lever was in the sixth notch, the boiler pressure 195 pounds, and the reverse lever has been moved to the tenth notch.

The record above this is made by a telegraph key operated by a lookout at the car window. The observer presses the key when passing any point which will aid in locating the record in regard to the track, as a station, mile post, bridge, signal tower, etc., and he calls to the observer at the table, who notes on the record paper what this notch means. A notch is also made every five minutes, exactly on the second, as at *G*. With these records and the indicator cards, knowing the weight of the train, the grades, etc., many useful results can be worked up.

The part of Fig. 1 on the right was made when the train was running at a slightly increasing speed of from 11.2 to 13.6 miles per hour, the pull varying from 26,650 to 25,250 pounds.

The record shown in Fig. 2 was made with a passenger locomotive pulling a 10-car accommodation train. The value of the ordinates is 3000 pounds per inch, and so, at the right, the record shows the drawbar pull to be 6450 pounds; and, as the notches in the time record are for five-second intervals, the train was making a speed of 40.9 miles per hour. At *C* the throttle was closed and the pull ran down to zero; then application of the engine brakes caused a push between the train and the engine of nearly 2000 pounds, and later of 2700 pounds. That the record changed from pull to push is shown by the first record above the dynamometer record, where the pen draws the line above its normal position when the load is pull, and below it when the load is push. At this time the mechanism had not been quite correctly adjusted, so that, while it recorded correctly the instant the load changed from pull to zero, it did not show the change from zero to push until the push became quite considerable.

At *D* the application of the train brakes was sufficient to cause a pull between the locomotive and train, which varied from zero to 4500 pounds, as the train slowed up, and finally stopped at *E*. In order to see how much the locomotive could pull in starting the train, the engineer was ordered to put the reverse lever in the first notch; that is, to give the greatest amount of valve opening possible, and start the train as quickly as he could. The result is readily observed, for, in going the 440 feet from *E* to *F*, the speed increased to 15 miles per hour in 40 seconds, and the drivers slipped four times.

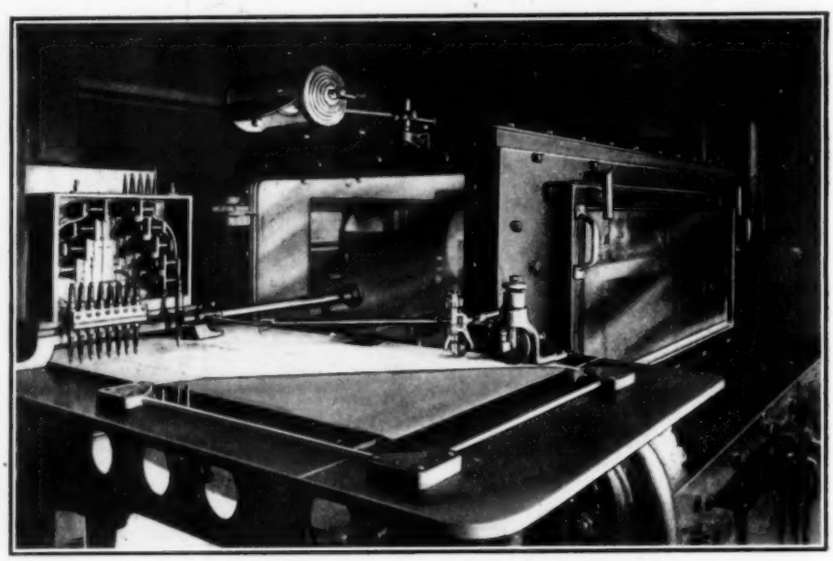


FIG. 8. THE PAPER TABLE AND INSTRUMENTS

In each of these records each cycle of motion is made during one revolution of the drivers. In the record made by the freight engine at low speed the beginning of each piston stroke can be easily discerned. On one run where the car was at the rear of the train, with a pusher between it and the train, and a second pusher behind the car, when both pushers were working with the train on a very heavy grade, all eight impulses on the pistons (as the valves were opened) can readily be seen.

Figs. 9, 10 and 11 show full-sized sections of the dynamometer curve, referring to particular points on the curves of Figs. 1 and 2.

General Arrangements of the Car

Fig. 3 is a photograph of the car complete, its length over end sills being 47

feet 6 inches, and its weight 108,000 pounds. In general, the internal arrangement is as follows:

At the platform end, on one side of the aisle, are a hot-water heater and a large closet for supplies, paper, ink, etc. On the other side of the aisle are a closet for coal, oil, etc., and a large closet in the lower part of which is a case in which the recording springs of the dynamometer are kept immersed in oil when not in use, the upper part of the closet being used for coats, etc. These closets are lighted with electric lights, which are turned on by the opening of the doors.

The living room comes next, takes a space of four windows on a side and contains four upper berths, two sofa beds and two cabinet beds, also several chairs and a table which can be taken apart and stored under the berths. Here the results of the runs can be worked up, or the room used as a dining room (utilizing electric cooking utensils), or for sleeping quarters.

Next come the lavatories, and then the working room, which has eight windows on either side.

The provision for electric current consists of four sets of storage batteries carried in closets under the car floor, each battery consisting of sixteen 2-volt cells. The lamps and small motors are built for 65 volts. These batteries are usually charged from outside sources, but when off on a long trip this may not be convenient; for this reason an 85-volt dynamo is installed in the car, direct driven by a kerosene engine.

The trucks are extra heavy, and the second or inner pair of wheels on the truck at the platform end of the car are not provided with brakes, but are accurately turned to such a size that the axle has a certain number of revolutions per mile-travel of the car. This axle carries a spiral gear which drives a shaft running longitudinally of the car, which eventually drives the paper across the table under the recording pens. The drawbar at the bobtailed end of the car is the one which connects with the dynamometer.

General Principles of the Dynamometer

Before designing the dynamometer several different systems were considered. Finally it was decided to use an hydraulic apparatus in which all the load on the drawbar is transmitted directly to the piston of a large, double-acting hydraulic cylinder, the cylinder being fastened to the frame of the car and having valves so arranged that, no matter whether the load is push or pull, the end of the cylinder carrying the load is in communication with a smaller cylinder, and the other end of the large cylinder is in communication with a supply tank. The small cylinder contains a piston which the liquid endeavors to force out, but the motion of which is resisted by compression springs, which compress until their resistance exactly balances the hydraulic load on the piston. Knowing the relative areas of the two pistons, and the rate of the springs (that is, the amount they will compress for a certain change of load), the load on the drawbar, corresponding to any compression of the recording springs, can readily be determined. Also, by putting in various sets of springs, the value of an inch of compression can be varied.

An extension of the piston rod which carries the pistons of the recording cylinder carries a pen, which moves over the paper on which the record is made, and the distance of this pen above the base line measures the amount of load on the drawbar.

After the design was completed and the work started, it was learned that the Chicago, Burlington & Quincy Railroad had also designed a car on the same principle,

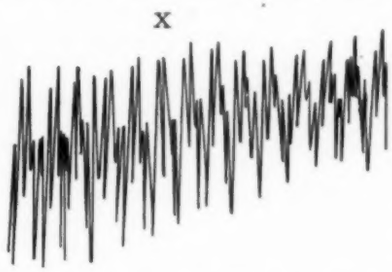


FIG. 9. FULL SIZED RECORD AT X, FIG. 1

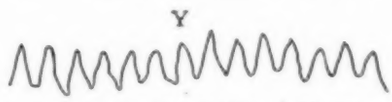


FIG. 10. FULL SIZED RECORD AT Y, FIG. 1

FIG. 11. FULL SIZED RECORD AT Z, FIG. 2

but neither designer knew of the other's work.

Fig. 4 is an interior view of the car, looking from the door at the platform end, and it gives a very good idea of the sleeping apartment, and shows the doorway leading into the workroom. Fig. 5 is taken from this doorway and shows the workroom, the trap door over the main press being removed; the two pipes leading from the main press to the recording cylinder and to the supply tank, and a portion of the main press itself can be seen, while at the right appear the engine and dynamo already mentioned.

Fig. 6 gives a very good idea of the workroom, looking from the other doorway.

All the parts of the main press, drawbar, safety springs, etc., are carefully protected from dirt by being in a closed chamber, but the action of the parts (except the main press) can be watched through the windows in the lower case, which, if necessary, can be very quickly removed. The recording springs, cylinder, etc., are in an entirely separate case over the other.

The Paper-driving Mechanism

Fig. 7 gives a very good idea of the paper-driving mechanism. In the forward end of the lower case is a vertical shaft which is connected by gearing to one of the car axles, as already mentioned. On the upper end of this vertical shaft is a bevel gear which meshes with two gears running on a horizontal shaft. This horizontal shaft projects out through the case and is the lower shaft in Fig. 7, or the one with the crank handle. On this shaft, splined to it between the two bevel gears, is a collar provided with teeth, which can mesh with corresponding teeth in the hub of either gear, and this collar is controlled by a handle seen under the recording table. When this handle is in a central position, both gears run free on the shaft, but if it is pulled out, the splined sleeve moves and meshes with one of the gears driving the horizontal shaft; or, if it is pushed in, it meshes with the other gear and drives the horizontal shaft in the opposite direction. In this manner the operator can stop or start the paper in either direction at will. The small hand wheel beside this handle controls the throttle valve which throttles the motion of the liquid between the main press and the recording cylinder.

The paper is carried in rolls. The supply roll is the upper one shown, and the paper goes from there up through a slit in the table, over the top of the table under the pens, down through a second slit in the table, under a guide roll, back underneath the table, then down vertically to the driving roll and over on to the receiving roll, which is friction driven and which always moves fast enough to keep the paper taut. The drive roll is of bronze, with its surface slightly roughened, and its diameter is so proportioned to the diameter of the car wheels that the paper has exactly the desired motion per mile travel of car. A rubber-covered roll presses the paper firmly against the drive roll, so that no slip shall occur.

Fig. 8 shows the paper table, with the rod from the dynamometer recording cylinder projecting through the glass front of the case and carrying the pen which is making the record. Resting on the paper, almost below where the rod comes through the glass, is the instrument for ruling the datum or zero line, while next to it is the mechanical integrator.

The integrator wheel, usually standing at an angle to the motion of the paper, has a tendency to cause the paper to slip sideways; to correct this, the instrument at the right is provided, which consists of

a rubber wheel, rolling on the paper, which wheel can be set to roll at an angle with the paper. Beneath this rubber wheel, set in the face of the table, is another wheel the diameter of which is very carefully made, so that this wheel will have one revolution for every 10-inch motion of the paper; an electric contact carried by this wheel makes the 1000-foot record already referred to. At the left is seen the bank of eight pens the action of which has already been described. These are moved by magnets controlled by make and break contacts, or telegraph keys. One corner of the paper is covered by a sheet of glass on which the operator can rest his arm when making notes, without any danger of impeding the motion of the paper.

There are many other minor points of interest about the car, such as the switchboard by which any one of the pens can have the voltage on its magnet fixed at either 2, 4, 6, 8, or 10 volts, without changing the voltage on any other magnet. The details of the method of transmitting motion from the car wheels to the paper are novel, but cannot be here discussed; also, the various provisions made for taking care of the leakage are very interesting. Electrically driven pumps are provided which automatically start when this leakage has reached a certain amount, and stop when the oil which has leaked away has been replaced. There are also indicators, and alarm apparatus to call the attention of the operator if the electric pumps do not work and the hand pumps have to be used.

Another article will give a detailed description of the dynamometer itself and an explanation of some of the difficulties met and overcome in its construction.

Construction of Coast Canals

Congress at the session recently closed authorized the construction of an inland waterway from Norfolk, Va., to Beaufort, S. C., the route as recommended by the army engineers extending southwardly from Norfolk *via* the Elizabeth river, following the route of the present Albemarle and Chesapeake canal, Albemarle Sound, Croatan Sound, Pamlico Sound, Neuse river, and thence *via* Adams and Core creeks to Beaufort inlet. While the length of this waterway is only 204 miles, and its authorized depth ten feet, it has served to direct public attention anew to the long-cherished movement for the construction by the United States of inland waterways extending along the entire Atlantic seaboard to the gulf of Mexico. The conception and advocacy of some of these links date back to the colonial period, and they were live issues until about 1835, when the era of railroad construction began. In these days when small boats are multiplying fast, such a protected inland waterway would be likely to prove popular.

Sizing Holes without Reamers

By Frank E. Shailor

To those who make pieces similar to the part shown at *A*, the accompanying description of its manufacture will be of benefit.

The piece, which we will call a hub, is in this case made from aluminum, and the hole must finish exactly 0.125 inch. As aluminum raises havoc with reamers, we experienced difficulty in keeping the holes to size, not being able to ream more than 50 or 75 hubs before the reamer was a thousandth or two under size. Another serious item was the great waste of stock when turning the hub on the screw machine from 5/8-inch round stock, which was the diameter of the flange.

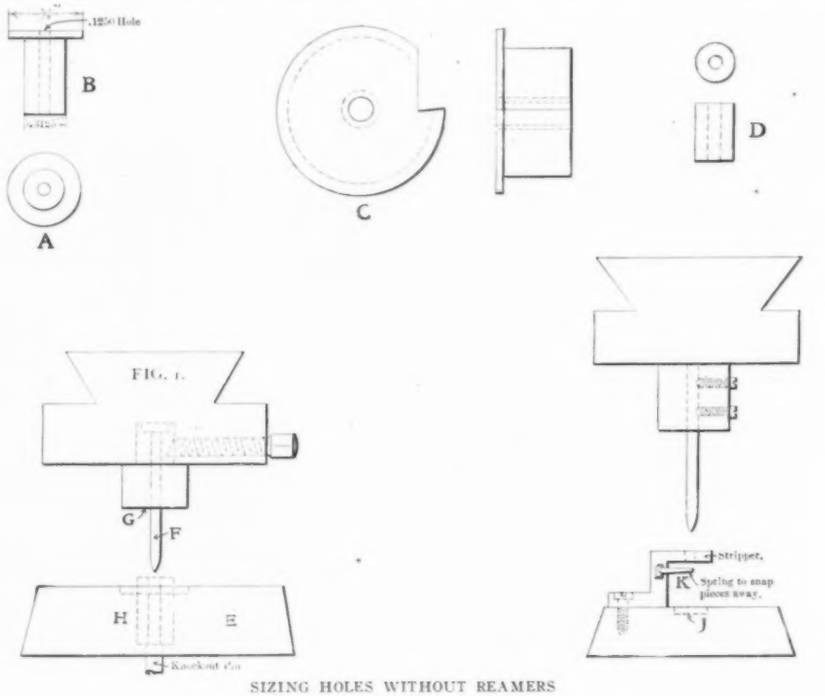


FIG. 1.

SIZING HOLES WITHOUT REAMERS

So I devised the method shown and can vouch for its being perfectly practicable. Instead of using 5/8-inch stock we use 5/16-inch aluminum rod, which is the size at *B*. A circular tool *C* for the screw machine was made to shave the end of the rod to exact length, thereby insuring all pieces being alike.

The screw-machine work consists of drilling the hole and cutting off, producing a blank as at *D*. The hole *H*, in die, was made the same depth as the distance from the under side of the flange to the end of the hub, and was made to fit the hub nicely. The punch *F* was hardened, ground and lapped to proper size, and was made long enough to pass clear through the hub before the flattening punch *G* touched the hub.

How It Is Done

Now the piece as it comes from the screw machine, having simply a drilled hole varying in diameter from 3 to 6 thousandths under size, is placed in the hole *H* and a lubricant dripped in the hole. As the punch descends, the plug *F* enters and sizes the hole, and the punch *G* strikes the hub and flattens it, producing the flange. The plug, being in the hole, prevents the hole from closing. On various diameters the size of plug will vary, as, for instance, a plug to produce a hole in aluminum exactly 0.125 inch must be 0.1258 inch, to allow for a slight closing of the hole after the plug comes out. Both the hole and the flange take on a glossy, smooth surface.

When reaming aluminum, the wear on the reamer is rapid, due to the "gritty" effect of aluminum when being cut. Also, on reamers we have only from four to six keen edges to withstand the wear, while by using the plug for sizing, thousands of pieces can be sized with the same plug.

We also use the device shown at *I* for sizing other parts. The piece to be sized is placed in a recess *J* only deep enough to locate the piece centrally with the plug. A stripper is, of course, necessary, and a spring *K* is added to snap the pieces away after stripping.

We have operators that turn out from 35 to 40 pieces per minute, or about 2000 per hour, which is 100 per cent. faster than when reaming.

To produce a smooth hole, especially in aluminum, and more so when the reamer is small, the reamer must not be crowded. A plug 0.125 inch in diameter will readily pass through and exactly size a hole that was 0.118 inch; and, strange as it may appear, the outside dimension is not perceptibly changed, even when not supported on the outside.

Inshaw's System of Manufacture of Solid Wrought-iron Tubing

By W. H. Booth

In the world of industry, operations that have grown into being to suit certain prevailing conditions have often been regarded almost as though they were the last word to be said on that subject. Perhaps no process ever appeared to be such a last word more than the bessemer process of steel manufacture. Yet the bessemer process has had its day of almost complete monopoly and has today to meet the competition of the open-hearth steel furnace, which is claimed by many to produce material with which the bessemer converter cannot compete in quality or even in price.

Wrought iron, which once formed the material for rails, ships and every other bit of iron work, was almost entirely displaced by steel, which was in a sense purer, was more homogeneous and was decidedly stronger, though it has never been shown to be so reliable as wrought iron. Indeed, wrought iron has never been completely ousted, and the finer brands of Yorkshire iron have always easily held their own at a very high price against the very best steel for such purposes as chains, anchors, cables, cage hooks and many similar purposes where the first essential is reliability and the second is the strength to a fair degree.

Wrought iron is not homogeneous; it consists of a greater or less number of rough fibers separated by a film of foreign substance or cinder, which is never completely extruded in the process of working. Wrought iron of high quality is made from pig of high grade, smelted by coke of a high order of purity and repeatedly cut and piled and rolled. The trouble with wrought iron was, until lately, that it could not be obtained in large masses. But this no longer holds good.

Wrought Iron in Large Masses

By means of mechanical puddling it is now manufactured in large masses and it is again coming more into use. Naturally the people of South Staffordshire, who have always been noted for their high-class irons, are particularly interested in anything that will bring into use wrought iron in preference to steel.

Now steel is unrivaled for certain purposes, but for other purposes it cannot show a durability to compare with iron. Especially is this the case with tubes. It has long been a source of trouble to boilermakers generally, and to naval men in particular, that steel tubes could not be made to withstand the influences of corrosion in the way that tubes of iron would do. The corrosive influences at work in a steam boiler seemed to concentrate all their energies upon the tubes, and steel tubes rapidly perished.

Pitting of Steel Tubes

They became perforated in very brief periods of time, and this action of perforation was particularly noticeable in the case of the thin, light tubes of torpedo boilers, for these tubes were so thin that they were perforated by a very slight depth of pitting. A desideratum in boiler work is a weldless tube, and it only required the weld to be practically abolished to bring wrought iron back upon the market as a material for tubes. This weldless ideal has been brought about by the patents of Mr. Inshaw, of Birmingham, England, whose process for the manufacture of weldless iron tubes practically abolishes the last risk of the weld.

Ordinary lap-welded tubes are welded up from thin strips, and it is rare indeed that some part of a tube is not of a less thickness than it should be, while many tubes are apt to possess a cold shut that cannot be detected by surface inspection. In order to weld safely and well, a fair mass of metal is required, and the weld should be made on a good surface. Welds in steel do not, moreover, possess the reliability of a weld in wrought iron. A mechanically made weld in wrought iron can be made soundly on a heavy mass by

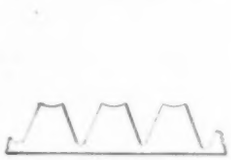


FIG. 1

FIG. 2

BLOOM FOR INSHAW'S WROUGHT-IRON TUBES

means of proper methods. Mr. Inshaw's method of making wrought-iron tubes starts out with the idea that the ingot must be hollow, and he sets out to weld up a heavy mass into a hollow ingot.

A Peculiar Looking Bloom

For this purpose he first rolls a peculiar bloom. This bloom when finished consists of a deeply corrugated mass of iron, like Fig. 1, in appearance in cross-section.

Let us begin where we wish to finish, however, with the hollow ingot of Fig. 2. Let a series of saw cuts be put radially from the hollow center toward but barely reaching the circumference. Let one cut be extended to the outside. Then if this hollow cylindrical thick ingot be opened out, it will appear of the shape of Fig. 1.

Now Mr. Inshaw commences by rolling his ingots as in Fig. 1, the pieces which project from the thin backing having the shape and irregularity of the cut blocks of the hollow cylinder of Fig. 2. If then any ingot of the form of Fig. 1 be bent up, it will form a complete thick, hollow cylinder like Fig. 2.

Makes a Hollow Ingot

If this folding up be done when the ingot has been heated up to a brilliant welding heat and the operation be mechanically performed by powerful machinery, drawing the folded ingot through rolls which compress the ingot upon itself with great force at a welding heat, the result will be a practically solid mass like Fig. 2, with all the welds done on ample surfaces. This is the solid ingot from which the new weldless wrought-iron tube is manufactured. The subsequent operations of drawing and reducing at maximum temperature are such that a finished tube is as though it had been made from the solid. This end can only be secured with a thin tube by drawing it down from a massive ingot welded up solidly in the mass at great pressure. Tubes thus made are absolutely even in thickness throughout, and the wrought-iron tube bids fair to replace steel for all purposes of the steam boiler.

Why Wrought Iron Is Better

The safety of wrought iron, respecting such duties as anchors and crane hooks, lies in the fact of its non-homogeneity. Should a fracture commence in a piece of good-quality bar iron, it does not extend readily beyond the first fractured fiber. A similar crack in steel is apt to extend very quickly right through the homogeneous material.

When a fracture commences in a steel plate it is customary to drill a hole through the extreme end of the crack in order to stay its further progress. The drilled hole is closed by a rivet. This drilled hole stops the continuity of the material, and this effect of discontinuity is inherent in wrought iron, each fiber of which, with its surrounding film of squeezed cinder, stands alone and independent. The fineness of the grain or fiber is obtained by repeated piling and rolling, so that the quality of an iron is a matter of the sufficiency of the work put upon it.

Testing the Grain

The fineness can be seen if a bar of iron be steeped in a weak acid solution. There is at present a very decided tendency toward the use of wrought iron in larger masses, and this is being fostered by the South Staffordshire men, who have stuck to iron all along in face of great discouragement. But it has always had its uses in that district of chain cables and anchors and only waited better mechanical means of turning it out in larger blooms for other uses to be found for it in competition with steel. Mr. Inshaw's new tube system is one of these uses, of which the demand of the boilermaker and the user bids fair to make a commercial success.

The international commerce of the world now exceeds 26 billions of dollars, of which 13¾ billions is imports and 12½ billions exports. Of the imports of countries other than the United States, 14⅓ per cent. are drawn from this country, and of their exports, 9½ per cent. are sent to us.

Machine-shop Cost Estimating

A Computation Containing Much Addition, so That Slide-rules Do Not Show to Great Advantage. Use of Diagrams Suggested

BY GEORGE BILHAM

In fixing the price of a piece of work to be done by the machinist, with the drawing as a basis of operations, the question naturally arises as to what factors are to be used in determining the time to be taken to machine the piece.

The slide-rule illustrated in the article at page 802, Vol. 29, Part 2, should be a useful aid to those employed in fixing prices and estimating costs, provided it is used only in those cases to which it is applicable.

The greatest use which could be made of an instrument of this description is to find the value of the machining operation only, as performed by the machine; or it could be used to obtain the total value of an operation, instead of the machining value only. The factors on the slides could be given values of a different order to that proposed, then the result would bear a corresponding value; e.g., suppose the article is a dynamo spindle, and the operation is turning, then the value of the operation on one spindle of a certain diameter and length would bear a certain relative value for the same operation to another similar spindle of a different diameter and length. Constants could be worked out from previous observations and proved if thought desirable; and, as most articles made in large numbers, but varying in size are known simply by numbers for those sizes, the values could be obtained for all the operations and kept in a tabulated form for reference purposes; if estimates for a size not in the table were required, the value of each operation could be determined at once, by reference to the table of constants.

The Time for Machining only a Portion of the Question

The time factor in machine work, excluding the human element, is always constant for a given operation, provided that the conditions remain the same. This factor, which varies only within certain limits, is apparently the only factor provided for on the proposed slide-rule, leaving out the variable factors which are the source of most of the trouble that anyone who has to do with estimating costs has to contend with. These variable factors have led some to say that cost estimating is only guesswork, because at times certain conditions arise in the shops that cannot be foreseen and therefore provided for in the estimate. These conditions must necessarily arise where a general class of work is done, as, owing to pressure of work, the most suitable machine will not always be available; though with a plant laid down for the manufacture of a special article this will seldom occur.

Variable Conditions to be Contended with

In dealing with cost estimating generally, it should be borne in mind that most of the present-day engineering plants have grown up as the result of requirements in the past. Consequently we find in a great majority of cases that a large number of machines and tools are in existence, which, on account of their usefulness for a specific operation, as well as on account of the cost of new machines to replace them, it would be inadvisable to scrap indiscriminately. With these older machines in use as well as modern machines of the latest type, it will be found difficult to lay down an inflexible list of constants applicable to the whole. In some cases the relative cost of machine time to the man's time is as low as 1 to 6, and in very few cases is it as high as 6 to 1, and then only on large pieces where the surfaces to be machined are large (and the time required for setting the piece is low) and there are no intricate parts to be machined, necessitating the frequent stopping of the machine for the purposes of gaging and changing the tools, which must occur with complicated pieces.

Using Squared Paper Instead of the Special Slide-rule for Finding Machining Time

The use of squared paper is almost unlimited in the way of obtaining machine times, and if the sheets are grouped under speed headings (which is necessary when one cannot locate to machine, owing to pressure of work or other difficulties) and several feeds put on one sheet, it will be found very easy to obtain the time for a given width of cut, if the diagram has as its basis one inch of travel at a given feed, the time required for which is plotted vertically or as ordinate values, and the diameter of the work or length of stroke horizontally or as abscissas. The time read from the diagram × width of cut gives the required time to do the machining.

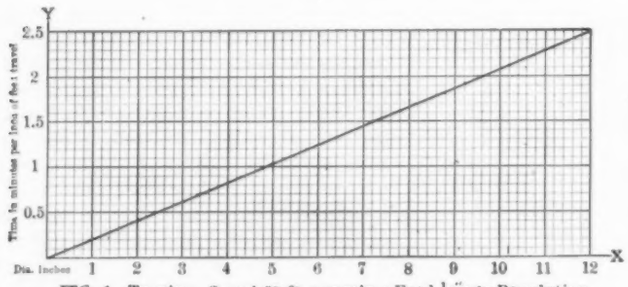


FIG. 1 Turning, Speed 30 ft. per min.; Feed 1/24" per Revolution

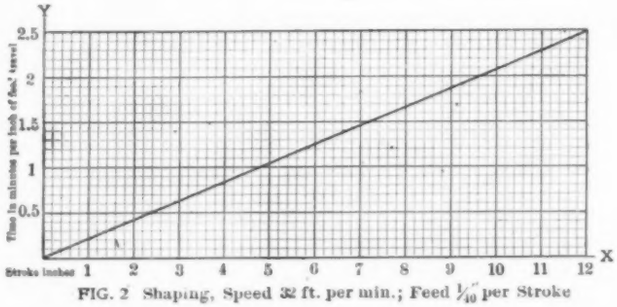


FIG. 2 Shaping, Speed 32 ft. per min.; Feed 1/40" per Stroke

MACHINE-SHOP COST ESTIMATING

Fig. 1 shows a diagram used for turning at a speed of 30 feet per minute with a feed of 1/24 inch per revolution. We will assume that the piece to be turned is 5 inches diameter with a cut 20 inches along the axis; with the diameter ordinate at 5 inches in X we see the line intersected at about 1 minute in Y (actual time 1.04 minutes); then 1 minute × 20 (width of cut) = 20 minutes, the time required.

The illustration at Fig. 2 shows a diagram used for shaping; this time line is based on the average of the cutting stroke and return stroke, combined so as to eliminate any additional factor, the speed being 32 feet per minute, with a feed of 1/40 inch per stroke. We will assume that the piece to be machined requires a stroke of 12 inches and that the

width of cut is 8 inches, with the stroke ordinate at 12 inches in X we find the curve intersecting at 2.5 minutes; then 2.5×8 (width of cut) $= 20$ minutes, time required.

Time Required for Machining Found Either by Diagram or by Slide-rule

If the proposed slide-rule could be modified to give the machine time with one constant for turning and a second constant for reciprocating machines, it would obviate the necessity of preparing the diagrams on squared paper, as illustrated. The rate factor would be eliminated with the price factor, which could always be obtained; and as the cost of the operation is always time $\times$ rate, the calculation then required is of the simplest.

The Time for Fixing the Work on the Machine

In the first place the piece must be fixed to the machine so that it can be operated upon. Now, this operation may take any time from one minute or even less under the most favorable conditions with a small piece to one day or more (engineering jobbing production considered) with a large piece, which requires to be set several times, and which requires a quantity of rigging to fix it to the machine. This we will call factor No. 1.

The Time for Taking the Cuts

The next factor to be considered is the time taken by the machine for the operation; this may be only one cut on a small piece, taking a few minutes, while on a large piece there will be several cuts at varying speeds (where these are obtainable) and feeds.

This factor can be determined provided that we are acquainted with all the conditions as to number of cuts required, and the speeds and feeds arranged for on that particular machine. In theory, the cost estimator should have, in a tabulated form, the different changes of speeds and feeds for each machine, as arranged for by the various belt-cones or pulleys and gears; but with a large plant of varied types, it will be found more convenient to use a compromise in speed and feed suitable for the size and type of machine where the operation is likely to be performed.

This factor we will call No. 2.

Time Required for Returning Tools, Regrinding, Etc.

On factor No. 2 depend the next two factors required. The number of cuts will determine the number of times the tool must be changed or returned to the starting position, varying from one-fourth minute at the turret lathe to five minutes at the large machines; the width of cut and hardness of material will determine the durability of the tool and number of times it must be ground, varying within very small limits for most machines. This we will call factor No. 3.

Time for Gaging

Then we must allow for the gaging of the work. This may be only a few seconds on a small piece of work, while on the larger or more complicated pieces it will be determined by the number of sizes involved and faces to be machined; also curves, angles, and radii formed by special tools, must be very carefully gaged and kept up to size. This we will call factor No. 4.

Time for Removing the Work

Assuming that the piece of work is now finished, it must be removed from the machine; if a number of small pieces are being operated upon the time occupied will be very small, while on one large piece which may require the crane to remove the work and also the angle plates, jigs, etc., and cleaning down the machine so as to leave it in readiness for the next job, e.g., planing, slotting, milling and boring machines, the time to be allowed may be as much as 1½ hours. This we will call factor No. 5.

Summing Up the Various Items

Having now obtained a series of factors representing the various operations necessary to produce a piece of work on a machine, we can proceed to estimate the cost.

From this series of factors, without which the work cannot be done, we can deduce no definite formula, as apparently four out of the five factors are almost invariably different for each different piece of work, although Nos. 3 and 4 depend on No. 2, and the same factors will vary in a lesser degree for the same piece of work on the same machine, corresponding to the number of pieces operated upon, since upon this number depends whether the time for initial operations (such as setting up the machine, preparing tools, obtaining gages and the necessary information) is spread over a large number of pieces or the whole time charged to one piece.

From this analysis we obtain the following results:

1. Time for setting up work and machine.
2. Time for machining piece.
3. Time for changing and grinding tools.
4. Time for gaging work.
5. Time for removal of work from machine.

The sum of these = the total time required.

Total time $\times$ rate of workman = wages cost of the machining operation.

Too Much Addition for Slide-rule Computation

These summation factors do not lend themselves to logarithmic computation, so that it does not appear that the calculation as a whole will be solved by the use of a slide-rule. That such an instrument would be useful in many ways there is no doubt, especially as the whole operation can be reviewed on completion, a distinct advantage over the ordinary slide-rule.

Things to Think about

By John R. Godfrey

There seems to be a general complaint among builders of machine tools that buyers and users often fail to give sufficient information as to work to be done, accuracy required and other details. Then, too, some users refuse to buy or make a tool equipment that would perhaps double the output of the machine; while they do not complain, it is a poor advertisement for the tool and it might just as well be earning a larger dividend on the investment.

There is also a question as to how far the maker should guarantee either the quality or quantity of the work to be done. He knows what can be done with it in good hands with a proper tool equipment, but he also knows that it is often placed under incompetent supervision, is handled by prejudiced workmen, and only the barest tool equipment is provided. If the entire loss came on the user it would not be so bad, but it is a constant reflection on the machine itself.

One Case of Poor Equipment

One flagrant case of the effect of poor tool equipment recently came to notice in the case of a turret-head boring mill in a good-sized shop. It was working away with one tool in the turret, when three or four could have been used to advantage, and though attention was called to this by the maker, who showed what an increase in output could be made by a small outlay for tools, the mill is still jogging along at its old gait.

Guaranteeing Another Man's Work

Another maker of boring machines refused to take an order that called for a guarantee of accuracy within 0.001 of an inch. Not that he could not secure these results in his own shop, but he knew the class of men who would handle the machine in the shop of the buyer, and he had serious doubts as to whether the buyer really knew what 0.001 of an inch was. The term "accurate within 0.001" is subject to a varied interpretation, according to the work in question, and the individual idea of the man in charge.

Give All Dimensions

Another difficulty is with insufficient information when repairs are wanted. It is bad enough when the order comes to "send a left-hand gear bracket for the machine we bought five years ago." This might be traced out if your records were fairly complete, but it often happens that

such parts as gears are wanted for a machine you didn't build.

A recent case of this was where a large concern sent a hurry order, with a sketch, for a pair of bevel gears for a drill press. No maker's name was given, and while the number of teeth was on the sketch, there was no mention of either diameters or pitch. As a result, the order had to be delayed until this information could be obtained.

Being Fair to the Maker

When a machine or tool breaks down, it is often easier to blame the tool than yourself. If it gives way doing more or larger work than it was designed for, it is quite a test of veracity, for it is very easy to imagine it must be the fault of the tool, and not your own. If you can just put yourself in the other fellow's place and forget that he might want to blame it on you anyhow, it may be easier to work the square deal.

Changing Men Every Six Months

The question of apprenticeship crops up at odd times and places. One shop, building a well known product (not in the machine-tool line) and employing about 800 men, reports 1600 men hired and discharged (or left of their own accord) in a single year, practically changing their entire working force every six months. Think of what it means to break in new men as often as that, of the effect on your organization, and the smaller output that necessarily follows.

And this firm doesn't have any apprentices, because they believe they do not pay. This means that every real mechanic they have has been trained by someone else and they have hired him away.

A Few Questions

How many have been discharged for poor work, and what does it cost them to find it out? Has a firm which does nothing toward making good mechanics any right to expect to get them, or the best of them? And can they hope to compete with shops having men trained to their special work, who stay year after year, and, knowing the methods, give a larger output per man and per tool than is possible where no one stays over six months on the average?

The bird of passage has no loyalty for his temporary roosting place, and in such a case as this, what has he to be loyal to?

Do Apprentices Pay?

Assuming that apprentices do not pay in dollars and cents, is it not cheaper to charge it to shop expense and have mechanics skilled in your own line than to try to run a shop on what drifts away or can be lured from other shops? Is it not as necessary to a well organized shop to have a good source of labor supply as it is to obtain its power or raw material economically?

But there are shops which employ apprentices in large numbers and stand ready to prove that they do pay from any point of view you wish to consider.

These shops give a boy an all-round training in every department, under competent foremen instructors, and turn out mechanics who are welcome in any shop, especially shops of the kind mentioned as changing its force every six months.

It would seem as though the only way for a shop or a nation to maintain its position in manufacturing is to keep up its supply of trained mechanics.

The Pump That Fooled the Young Repairman

By George

When a mechanic is called upon to doctor a piece of machinery whose performance proclaims the fact that it is indisposed, he will first, if he has acquired wisdom in his craft, make a careful examination—thump its wind, feel its pulse, look at its tongue, and, if it is able to move, put it through its paces, so to speak, before touching a tool. For possibly, contrary to the opinion and theory of the man in charge, which are pretty sure to be volunteered, the cause of the trouble may be extremely remote; a sort of sympathetic affection, you might say. In fact, when the experienced practitioner sets to work, he has taken into consideration cause and effect, and generally has a pretty clear idea of what is needed, always with a weather eye open for new developments that may turn up as the case progresses.

Jimmy was not exactly eligible to the class of experienced practitioners, but he was a pretty promising youngster in the advanced cub stage. He could gear up a lathe to cut *some* threads when you held your hand over the index plate; he had gone out on jobs to other towns with some of the men, and upon one occasion, when the shop was short-handed, he had even gone out alone and persuaded an obstreperous gas engine to resume the even tenor of its way—all of which, I am afraid, tended to produce in Jimmy a slight superabundance of self-confidence.

How the Pump Acted

Again the shop was short-handed when Hans Pumpernickel, who ran the little steam barrel mill down by the creek, wheezed into the shop in a veritable cloud of perspiration.

"Gott im Himmel!" exploded Hans, "mine bumb she von't bumb, und I can get no vasser in mine poiler alreaty. I loose a tousan tollars a tay."

Here was Jimmy's chance.

With manly stride and bulging kit he sallied forth. On the way he questioned Hans as to the pump's symptoms. Not that he needed any coaching; he would make his own diagnosis; but he was curious to learn what ideas mechanical oozed (he felt certain they merely oozed) around within the miller's round head.

"She go oud lik dis," elucidated Hans, thrusting his fist from him slowly and steadily, "unt she koom pack like dis." Here Hans suddenly shot his arm back with enough violence to dislocate his shoulder.

Jimmy smiled knowingly and, gazing away to the horizon with a wise look, muttered to himself, "valve."

The pump proved to be a little Knowles. It also proved to be situated in a not too commodious passageway, against the side of the boiler, which was anything but cool. As a preliminary, Jimmy turned on steam and watched the pump's action. The miller's graphic explanation fittingly described it.

Jimmy Gets Busy

Jimmy opened his kit and spread his tools out in imposing array. He then poured a pail of cold water over the hot cylinder and took off the steam chest. The valve appeared to be all right. The trouble must be in the outside gear. He took off the cylinder head, too, to make sure; everything all right there. He replaced the chest and head and examined the gear.

The valve was worked by a rocker attached to the trough, the rocker being moved by means of a roller on the piston rod. The movement of the valve was regulated by having the link which connected the rocker with the valve stem in two parts screwed together. The lock nut on the link was loose; the link must have unscrewed and lengthened. Jimmy started the pump and slowly screwed the link together. The piston merely took half strokes. He screwed some more. The piston was at once apparently stricken with fever and ague, for it began to tremble violently. Jimmy decided to screw the link out instead of in. Slowly he moved it, and after no little adjustment he got the pump to work as it did at first. Still he adjusted; the piston merely went to the other end of the stroke and threw another ague fit. Then back and forth Jimmy adjusted, but always with the same result. Perhaps the trouble was in the chest, after all; so off it came again and was given a close scrutiny. It certainly was a complicated looking affair.

Trying It Over Again

Jimmy was worried. The knowing smile had long since given way to that tense, drawn expression we read about in modern frenzied-finance literature, embellished by a few impressionistic streaks of grease, over which the perspiration trickled in grimy streamlets. Jimmy was not the only one worried. From his perch on the waste can Hans would demand ever and anon:

"Can you fix him, hey?"

To which demands Jimmy answered in the affirmative, in which assurances a close observer might have detected a slight falling off from the true ring.

Jimmy tentatively moved the piston and valve back and forth and tried to fix in his mind some relation between the outside gear and the valves; but the more he tried to think, the more confused his mind became, until his head fairly hurt. In fact, at the end of fifteen minutes' concentrated brain bruising he could not have sworn whether the piston moved the valve or the valve the piston.

"If it was only a steam engine," he wailed to himself, "a fellar could see how it went; but this cussed thing not only slides back and forth, but twists around, and I'll be hanged if I know what it don't do."

Stopping to Meditate

To facilitate the working of his mental apparatus, Jimmy sat down on what appeared to be a cold-water pipe. The pipe was anything but cool, and Jimmy arose with an alacrity that precipitated him several feet in the air. When he again landed he kept right on going, his one idea being to get as far away from that pump as possible in the quickest time. It was not just plain pump either; for the heated condition of his mental machinery, together with the high temperature recently generated at the other extremity of his anatomy, produced a potential that escaped in a string of sizzling adjectives, usually represented in print by a series of dashes and exclamation points.

Outside a cool summer breeze fanned his fevered brow, the sun shone brightly and the birds sang sweetly; the world was not such a dark chaos after all. Jimmy reconsidered. He would tackle it once more.

Now just here, according to the formula for producing modern literature, Jimmy should have gone back to that pump with the light of determination in his eye, and, after an heroic struggle, matter would have succumbed to mind. But there wasn't any light of determination in his eye; the pump had him beaten to a standstill. He must tackle it again, however, or be laughed at. As he turned with leaden steps, an angel-like vision came into view.

To ordinary mortals it was only a grimy machinist returning from a job with a sack of tools on his way back. To Jimmy the face was cherubic, the sack was sweeping wings. Jimmy ran forward and headed off the passing angel.

"Oh, Ben," he called, with a world of supplication in his voice, "come over here, will you? I'm stuck."

The latter admission plainly indicated to what depths of self-abnegation he had descended.

Ben Looks It Over

"'Pears to be all right here," vouchsafed Ben, after examining the valves. "Now you put it back and adjust the gear back somewhere near where it was."

Jimmy, only too glad to take orders, hastily obeyed. When the chest was once more in place and all connected up, Ben turned on steam. The piston moved out steadily and came back like a coiled spring. In the soul of Jimmy there was quite a trace of exultation; for, if Ben should get stuck, there was some justification for his own failure.

But Ben did not appear to be greatly worried; instead, to Jimmy's amazement, he told him to open up the water end. There did not appear to be anything the matter there, except that one of the valve springs had broken and a part of it lodged in the holes in the valve seat. Ben pulled the bit of brass out and told Jimmy "to close her up." When steam was turned on the pump went to work with a smoothness that shattered the gloom of Hans into an expansive smile of satisfaction.

"Son," demanded Ben, gazing down with pedagogical severity at the gaping cub, "what does an ingine do when she has no guvner and the load is thrun off?"

"Why," answered Jimmy, dazedly, "she races."

"Exactly," answered Ben; "an' when a suction valve of a pump is held open, the load is offen her on that side, and she races on that stroke. Next time you doctor a pump, don't fergit that the valve can be set in the water end."

Laborers in Canada

It is estimated that 60,000 laborers will be needed during this season in different sections of Canada in constructing new railroads. New steamers are going into commission, and all available ones will be chartered for the new immigrants that are booked in Great Britain for the Dominion. As an inducement, laborers have only to pay $4.84 on their passage, the balance to be deducted from their wages. They are guaranteed $2 per day.

The Artisan Vise

We show by the half-tone, Fig. 1, and the line cut, Fig. 2, the vise mentioned in our interview with Professor Sweet about the Artisan School.

In speaking about it he said that when he made up his mind to start in on vises he went out into the shop to see what was the matter with the present sort, and soon found out; then he set about making that part better.

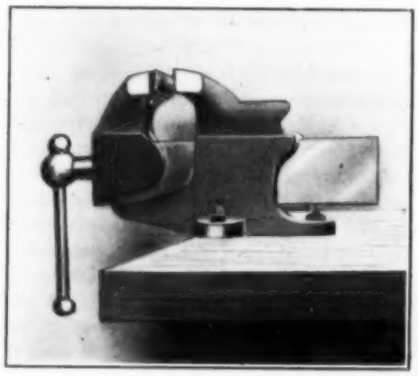


FIG. 1. THE ARTISAN VISE

By referring to Fig. 2 it will be seen that both collars on the screw are made out of the solid stock. The bush *A* is made a running fit on the neck of the screw and between the collars, and a drive fit in the socket counterbored in the sliding bar. It is then split open, put on the neck and forced in place.

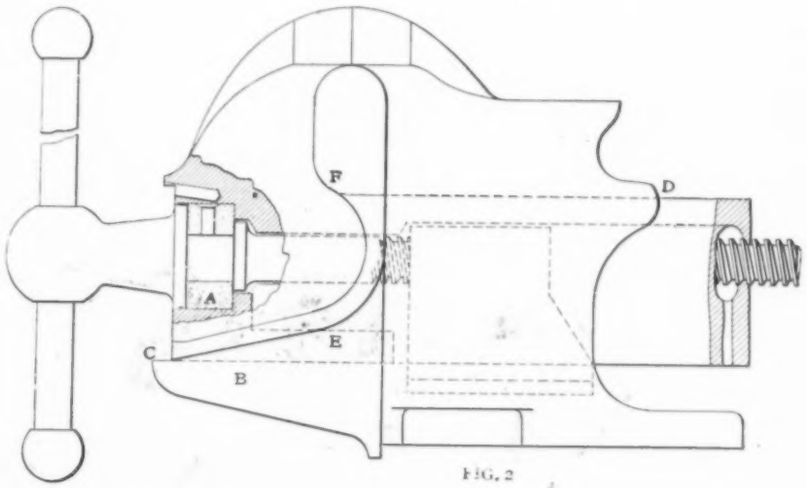


FIG. 2

FIG. 2. DETAILS OF CONSTRUCTION OF THE ARTISAN VISE

No dirt nor grit can find its way into the shoulders, the working parts can be oiled like any journal, and lost motion is pretty well eliminated.

The sliding bar is strengthened where it usually breaks at *F*; the horn *B* is longer than others, and is strengthened by the ledge *S*. The friction points *C* and *D* which offer the main frictional resistance, are about 50 per cent. farther apart than

usual, which reduces the friction to a marked extent. The ratchet thread is, perhaps, 50 per cent. stronger than the square thread.

There is just enough difference in appearance from the regular sort to show some evidences of design.

Straits Settlements Tin

Consul General D. F. Wilber, of Singapore, reports on the tin industry of the Straits Settlements as follows: The exports of tin from the Straits Settlements for the first seven months of 1906, as compared with the same period of 1905 showed that shipments to English ports had increased 33⅓ per cent., and those direct to the United States had decreased 40 per cent. The total exports of tin for 1906, as compared with 1905, show an increase to English ports of a trifle over 9 per cent., and a decrease in direct shipments to the United States of 12½ per cent. This indicates that during the latter part of 1906 American buyers were gradually increasing their purchases of direct shipments and avoiding the so-called optional shipments via England. The output of tin for the Federated Malay States during 1906 was 48,616 metric tons, against 50,991 tons in 1905. The imports of tin into these States during 1906 was 8078 tons, and in 1905, 7628 tons, mostly from Siam and Netherlands India.

Making the Rolls to Produce a Reinforcing Bar for Concrete Work

By E. A. Dixie

If you will glance back at page 229 you will see a half-tone of a reinforcing bar that gave the inventor, and incidentally those who got the rolls out for him, quite a lot of worry before it was made. The bar is used in reinforced-concrete work

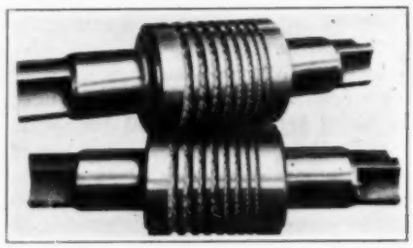


FIG. 1. A PAIR OF ROLLS

and is virtually a round bar with two longitudinal rounded ribs, one on either side, and two spiral rounded ribs, one right and the other left hand. The inventor of the bar wrote to several concerns who seemed competent to handle the job, but only one, the Philadelphia Gear Works, cared to tackle it after the first look.

Fig. 1 shows one pair of finished rolls. In these the spiral grooves that form the spiral ribs on the bar are well defined. The grooves for the longitudinal ribs are better shown in Fig. 3. They run along either side of the large grooves and are half in one roll and half in the other. Besides their functions in the finished bar they assist in the flow of the metal while being rolled.

As there was no machine in the shop which would handle such a job of hobbing, as that was the method it was decided to employ to produce the spirals, a lathe was rigged up for the job, as shown at Fig. 2. A split driving gear was mounted as shown, direct on the reduced end of the roll. This meshed with a pinion connected through a flexible shaft with the miter gears which drove the vertical shaft carrying the hob. The bracket for the hob shaft is mounted on the lathe carriage so that it can be moved from groove to groove as necessary.

The first idea was that an ordinary hob with a number of teeth would do the work. Luckily a cast-iron test piece was tried first and it was found that a multiple-toothed hob was worthless for the job, as it made a groove wide at the sides and correct only at a point in the center of the large grooves. The multiple-toothed hob was then discarded and a single tooth used. One of these is shown on the carriage in Fig. 2. The flexible drive was then found inefficient. The

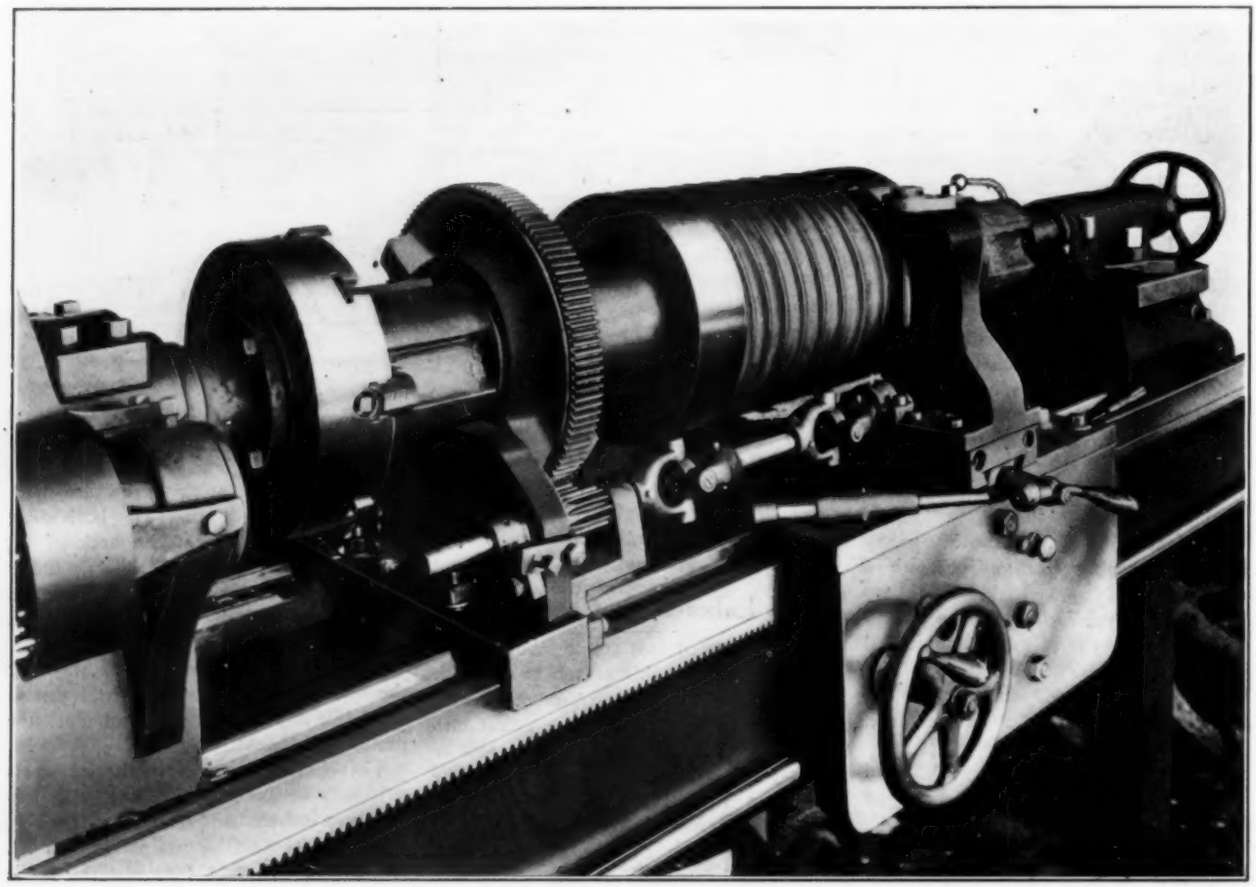


FIG. 2. THE FLEXIBLE JOINT DRIVE

lost motion at the various joints amounted to so much by the time the cutter was reached that it was liable to chew into the roll at any old place. The flexible shaft was then discarded and a direct drive through a straight shaft substituted. This eliminated all the lost motion occurring in the joints of the flexible shaft, and as the gears were spaced purposely as deep as they would run, there was no further trouble with the cutter not indexing properly. The change from right to left required an idler between the driving gear and the pinion.

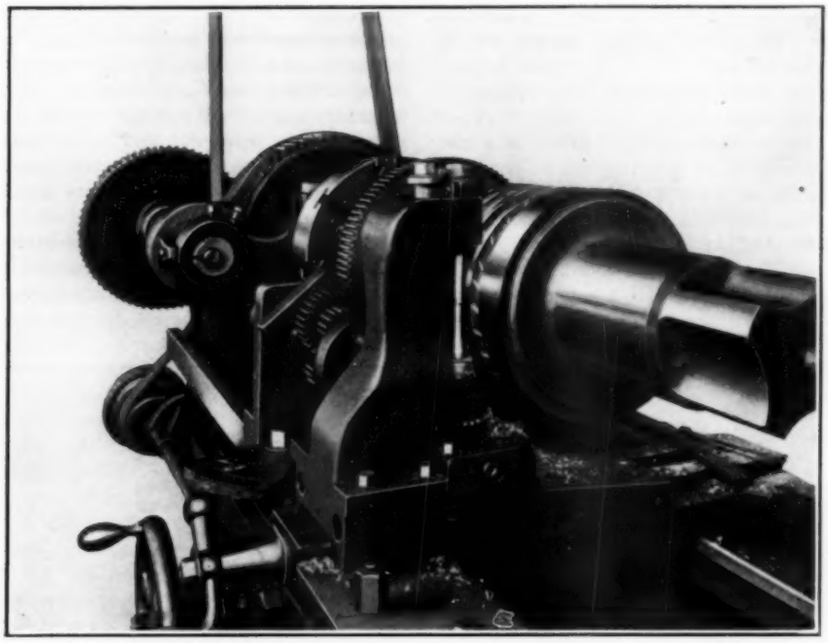


FIG. 4. THE SINGLE TOOTH HOB AND ITS SHAFT

Fig. 4 shows the spindle and cutter. On the small grooves, which are less than ½-inch diameter, the spindle is supported close to the cutter, as otherwise there would be too much spring in it. This is accomplished by having a piece of metal which is secured to the spindle bracket. Its center is at the hight of the tool. A slot is provided for the tool to pass. Above and below the slot the metal is shaped as a half bearing for the cutter spindle. In this way the cutter spindle is supported close up to either side of the tool, preventing it from bending while under the pressure of the cut. There will no doubt be those who will say this job ought to have been done on a generator, but the fact remains that it was done and done satisfactorily on an ordinary lathe with very little rigging up. The time necessary to machine the various grooves differs according to size and the time taken to get ready. I saw one of the grooves finished with the spirals in one direction in about an hour and a half. The material was 115 carbon forged steel.

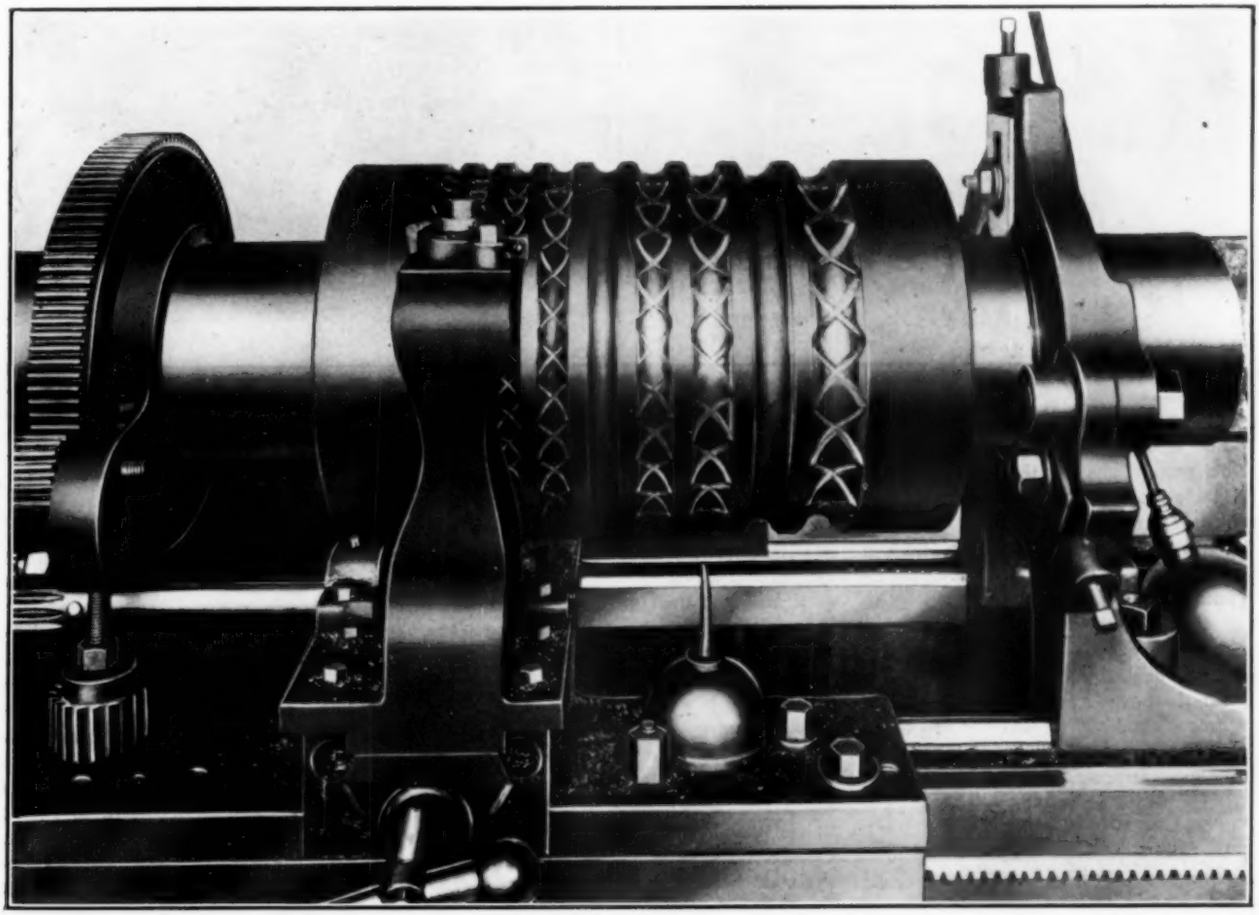


FIG. 3. THE RIGID DRIVE

A Heavy Plain Milling Machine

The accompanying engravings illustrate a new machine designed for the heavier class of milling operations and designated by its builders, the Brown & Sharpe Manufacturing Company, Providence, R. I., as their No. 4-B heavy plain milling machine. This miller is equipped with a constant-speed drive which may be operated either by countershaft or by motor, Fig. 1 showing the appearance of the machine as arranged for belt drive, while Fig. 2 illustrates a similar type of miller with motor attached at the rear of the base, the drive in the latter case being transmitted to the machine through the medium of silent chain and sprockets.

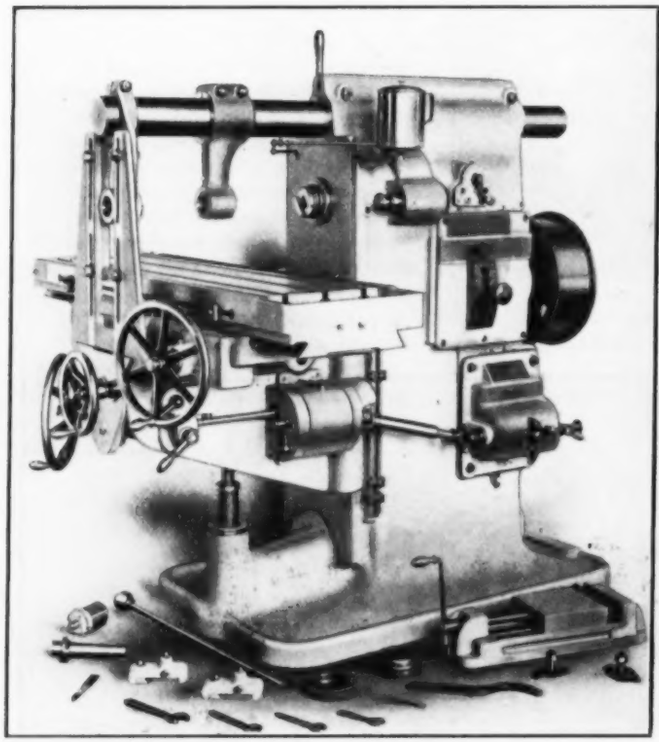


FIG. 1.

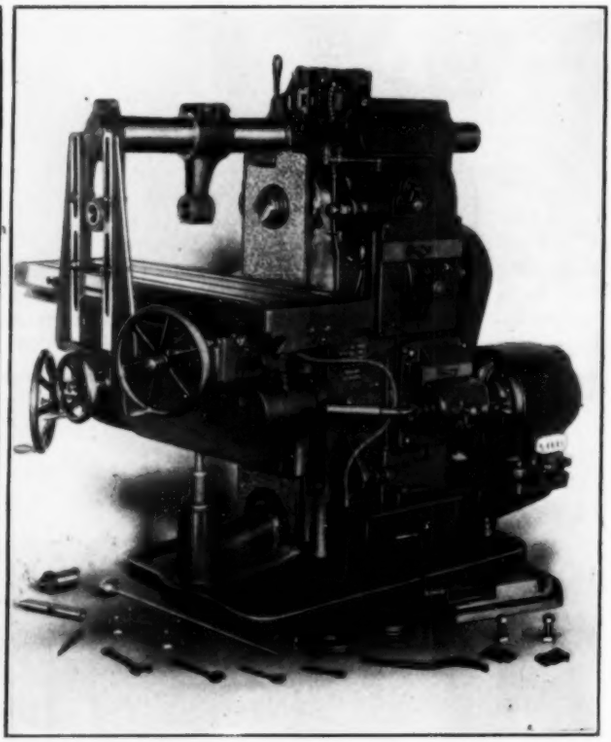


FIG. 2

HEAVY PLAIN MILLING MACHINES

The proportions of the column, knee and table and the heavy design in general are clearly brought out by the half-tone and the line drawing Fig. 3. It will be seen that the column is so designed as to house in the spindle, thus adding to the strength of the bearings and reducing the possibility of springing under heavy cuts; the finished surface forming a bearing for the knee is extended to the top of the frame, making it possible to clamp rigidly any regular attachment directly to the column face.

The Spindle and Drive

The spindle and its driving mechanism are illustrated in Fig. 4. This drawing shows clearly the proportions of the spindle, the method of supporting the bronze boxes, and the means of compensating for wear. The front end of the spindle is threaded to receive a chuck or large cutter, has a No. 12 taper hole, and a recess across the end with a cap nut by which an arbor or collet having a clutch collar is locked for driving. A knob on the right of the spindle upright can be pulled out and the spindle turned by hand when slight adjustments are required.

The main driving shaft, which is shown in the vertical section, is driven at a constant speed of 320 revolutions per minute by an 18-inch pulley operated by a 6-inch belt, and this shaft through gear cones and back gearing imparts to the spindle 16 rates of speed, varying in geometrical progression from 15 to 350 revolutions per minute, the gear ratios ranging from 1 to 1 to 21.3 to 1. The speed changes are controlled by means of an index slide and levers on the side of the machine. To change the speed it is necessary only to unlatch the lever in the vertical slot and move it down as far as it will go; then move the index until it is under the column on the speed plate corresponding to the required speed; the lever is then moved up as far as possible, the locking pin engages the correct hole and the proper gears are in mesh. The lever over the plate gives two series of speeds, one fast and one slow. The back gears are thrown in and out by a lever in the usual way; the locking pins that engage the spindle sleeve, which replaces the cone head, are operated automatically by the movement of the lever. The shafts and gears in this driving mechanism are hardened.

This constant-speed drive enables the spindle to be driven efficiently under all conditions. It provides for the use of the same size pulley on both the countershaft and machine, thus giving greater belt contact and driving leverage than can be obtained with the usual cone drive. When desired, a friction pulley can be substituted for the regular driving pulley, thus adapting the machine for driving direct from the main line and doing away with the necessity for a countershaft. The friction clutch is controlled by levers placed conveniently at either side of the machine. An interesting feature incorporated in this friction arrangement is a simple brake, which, upon the clutch being released, stops the spindle and acts as a lock when chucks or cutters are being removed from the threaded end.

Motor Drive

When the miller is equipped with either variable- or constant-speed motor the usual pulley is removed and replaced by a sprocket for a silent chain. As will be seen from Fig. 2, a suitable pad is cast on the rear of the base as a support for the motor bracket, so that a motor drive may readily be installed at any time without extensive refitting of the machine. With a variable-speed motor the spindle gearing is simpler than shown in Fig. 4, though the sliding gear is retained, this gear with the back gears giving the spindle four series of speeds controlled by the levers. With a 3 to 1 motor variation the speeds in the four series range from 9½ to 351 revolutions per minute,

each series having of course as many intermediate speeds as there are points on the controller.

The Table and Feeds

Fig. 5 shows the heavy design of table, saddle and knee, and illustrates part of the feed mechanism. The saddle has wide bearing surfaces on the knee, provides a long bearing for the table, and, in conjunction with the deep table and stiffly braced knee gives a rigidity that adapts the machine to heavy milling operations. The knee is elevated by a telescopic screw which does not extend below the base; when the machine is fitted with automatic vertical feed, adjustable stops are also provided. Conveniently located hand wheels fitted with knobs for controlling the engaging clutches are provided for longitudinal, transverse and vertical feed shafts; adjustable dials graduated to read to thousandths indicate the table movements. The table has quick return and slow hand feed, operated by hand wheel *A* at the right and front of the saddle. When knob *B* is pulled out, gear *C* is engaged by clutch *D* and gives quick movement of the table. With the knob pushed in, the clutch is engaged with gear *E* and slow feed is obtained, the motion being transmitted from the hand wheel through gears *C* and *F* to *E*. Gear *G* drives through pinion *H*, gear *J*, which meshes with *K* located on the feed shaft. To disengage the hand wheel when using power feed, the clutch *D* is brought to central position, a spring detent being provided to hold the clutch in different positions.

All levers for controlling the various power feeds are conveniently located at the right of the knee, as illustrated in Figs. 1 and 2. One lever on the front of the reverse-gear case serves to start, stop or reverse all feeds; the two other levers

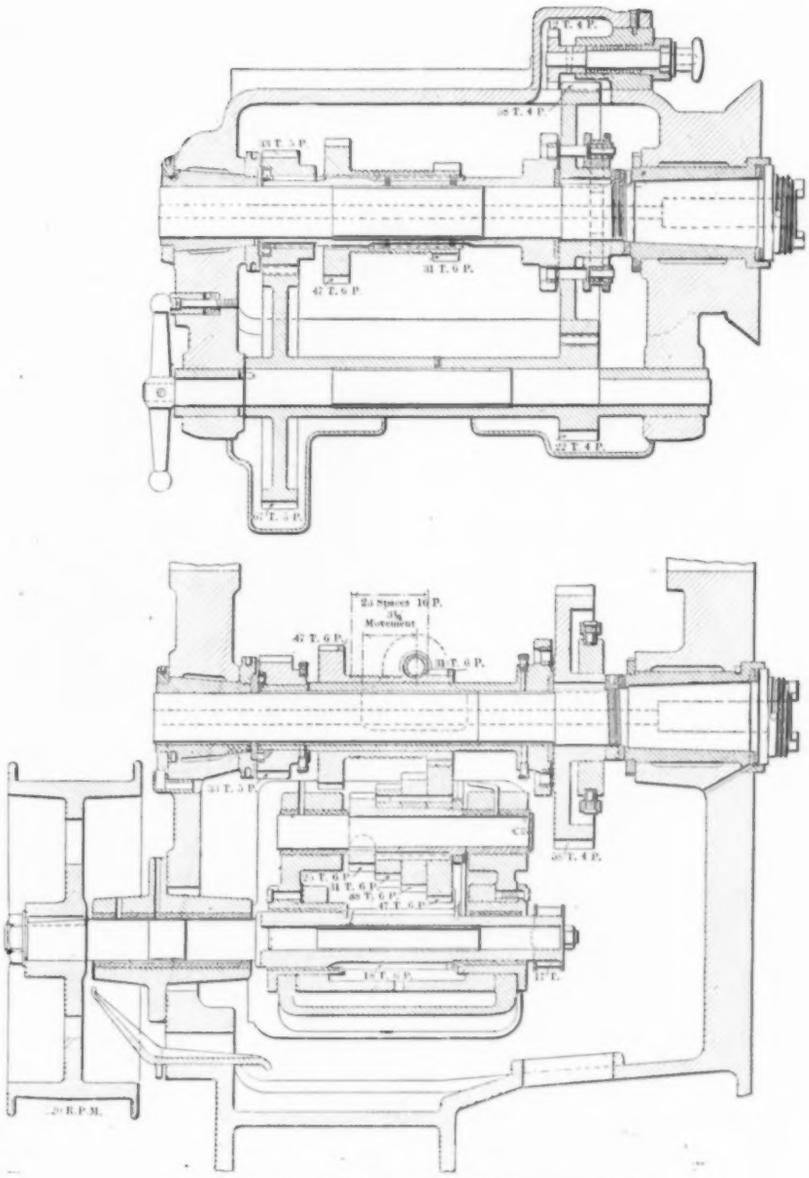


FIG. 4. SHOWING SPINDLE AND DRIVING MECHANISM

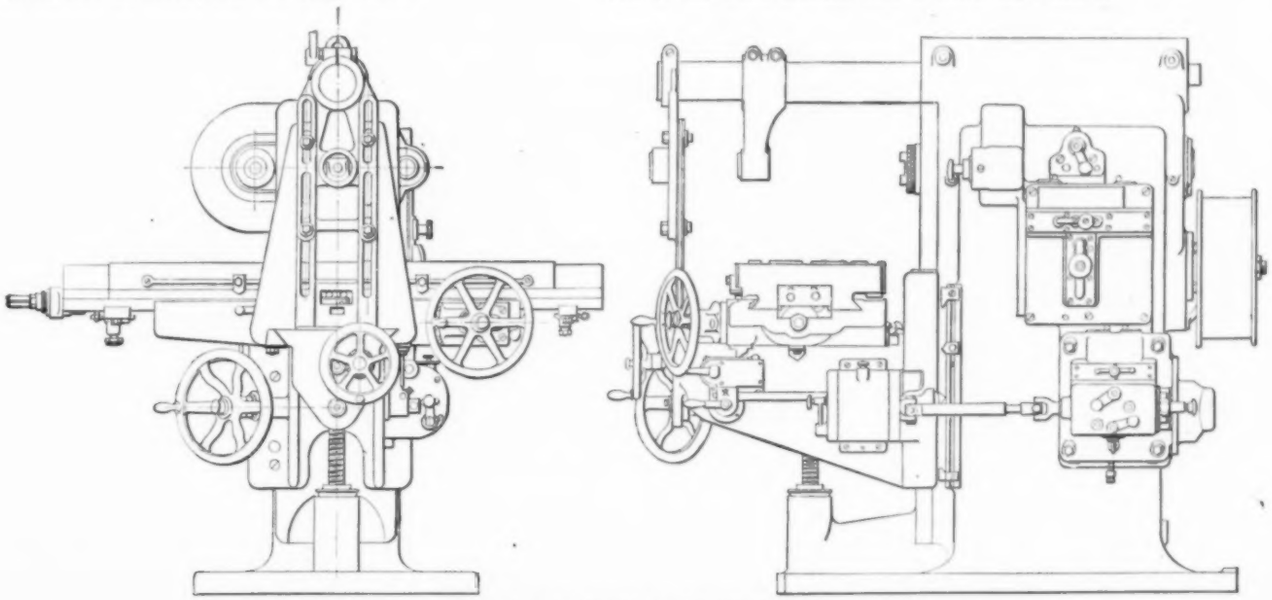


FIG. 3. FRONT AND SIDE ELEVATIONS OF HEAVY PLAIN MILLING MACHINE

control respectively the automatic transverse and vertical feeds when these are incorporated in the machine. The feed screw is not splined, the power being transmitted from the clutch gears to the table screw by an auxiliary shaft, and, as the threads are unbroken, the life of the screw and nut is prolonged and their accuracy maintained. The feed mechanism is new in design and gives a wide range of feeds, varying in geometrical progression. The gears are all spur and the drive is direct from the machine pulley shaft by chain and sprocket wheels which are inside the frame of the machine, thus eliminating exposed guards. As the shaft runs at constant speed, it is possible to obtain the correct feeds in relation to the spindle speeds in inches per minute. This method of driving gives a table feed that is independent of the spindle speed and also a fixed rate of feed in inches per minute for all diameters of cutters. The feed changes are easily and quickly obtained by the simple movement of an index slide and levers. To change the feed, the locking pin of the lever shown at the right of the feed case is withdrawn and the lever moved up as far as possible; the index slide is moved along opposite the column in the feed table containing the required feed; the lever is then moved down as far as it will go and the locking pin drops into the proper hole. The two levers give four series of feeds, two fast and two slow. The position of the levers for each feed is plainly shown by the feed table.

The sensitive tripping mechanism on the front of the saddle is of the double-plunger type. It can be set to prevent throwing in of the wrong clutch, and when the feed is tripped it is not necessary to run the table dog beyond the trip plunger to reverse the feed, the simple reversing of the tripping lever on the front of the saddle being all that is required. This mechanism is in addition to that on the side of the knee. The 16 feeds obtainable range from ⅝ inch to 20 inches per minute. The feed obtainable per revolution of spindle varies from 0.0018 to 0.057 inch, for small mills, and for large mills, from 0.041 to 1.33 inch. With variable-speed motor drive the feed changes are increased to 16 for each series of spindle speeds, the total range being from 0.0025 to 1.04 inch per revolution of spindle.

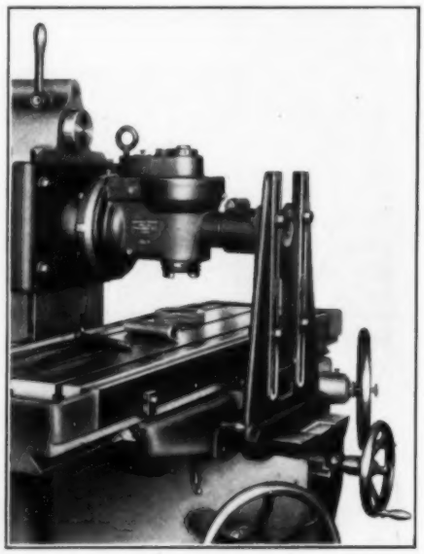


FIG. 6. VERTICAL-SPINDLE MILLING ATTACHMENT

Vertical-spindle Milling Attachment

Reference has been made to the provision for clamping attachments securely to the column face; this operation is further facilitated by the construction of the overhanging arm, which is a straight steel bar that can be pushed back entirely out of the way, thus avoiding the necessity of removing or reversing it. This arm is clamped at both bearings by a single lever; the supports are bronze bushed and an adjustable center is provided to fit either the outer or intermediate support for the arbor.

A vertical-spindle milling attachment designed for use on this machine is shown in Figs. 6 and 7, this device being proportioned to carry any cut the driving belt will pull. Aside from the general heavy construction, attention is called to the arrangement of the driving gears, which allow an unusually long spindle bearing, to insure rigidity under severe service. The drive is from the main spindle of the machine by means of a clutch arbor, through an intermediate bevel gear mounted upon an auxiliary shaft and driving the spindle of the attachment through spur gears, as shown in the sectional view. This arrangement allows of a bearing for the attachment spindle almost as large as that employed for the main spindle of the machine. Also the end of the spindle has the same size taper hole and is threaded the same diameter as the machine spindle. This allows the same size collets, chucks, face mills, etc., to be used on either the machine or attachment spindle. All bearings are bushed with bronze, all gears are of steel and hardened. The frame of the attachment is clamped directly to the face of the knee slide and has an outer support to insure additional rigidity.

The table of this heavy milling machine, including oil pockets and channels, is 69¾x19 inches, with a working surface measuring 57¾x19 inches. The total travel of the table longitudinally is 42 inches, the transverse movement 12 inches, the vertical movement 20 inches. The net weight of the machines is 8700 pounds. The vertical attachment weighs 500 pounds.

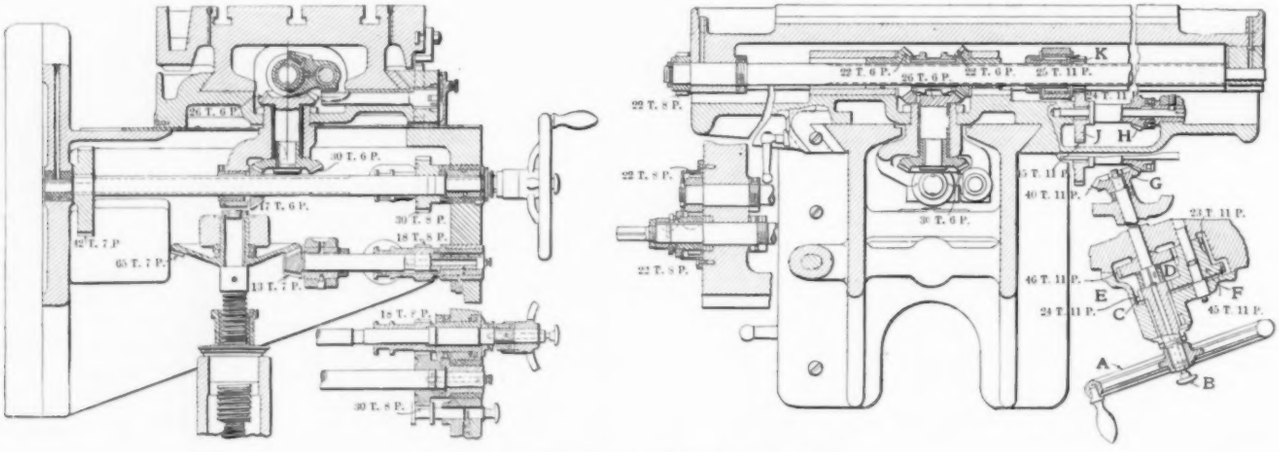


FIG. 5. SECTIONS THROUGH TABLE AND KNEE

Citric Acid Better Than Cyanide

By E. Viall

A good many toolsmiths advocate the use of cyanide on carbon steel because they say it cleans the surface and allows the water to get quickly to the surface of the steel, thereby preventing soft spots.

Now the result of my experience has been that if a quenching bath made up of one pound of citric-acid crystals to a gallon of water be used, it will beat cyanide all hollow. It not only prevents soft spots, but the steel has less tendencey to crack.

The New Engineering Trades Agreement Between British Employers and Workmen *

It is just ten years since we were on the eve of the most extensive and most momentous labor struggle in the history of our national industries. The engineering trade unionists were preparing to make a series of demands on their employers, marked by local strikes, which resulted in a general lock-out that paralyzed the engineering and shipbuilding trades throughout the whole country. This industrial war, which began in the summer of 1897, lasted until the beginning of 1898, and one of its most remarkable results was confederation. The engineering employers drew their various local associations together into a federation which is the largest and most skilfully administered organization of employers ever known in this or, perhaps, in any country. The respective trade unions engaged in the various engineering trades formed a definite alliance (not an amalgamation) among themselves, and also joined a general federation of shipbuilding and engineering trade unions. And there is no doubt that the formation of these federations has made for peace. When the great strike of 1897-8 came to an end it was upon a carefully elaborated and signed treaty which included provisions for the future working of the industry. These conditions came to be known as the "Terms of Settlement," and the effect of them has been to prevent strikes and serious disputes in the industry ever since. There have been frequent differences, no doubt, as there must always necessarily be in a great industry; but these have been purely local and have been harmoniously disposed of by the means provided. But it is not to be denied that the men—or at all events some of them—have felt for some time past that the terms of the 1898 agreement were drawn up when they were a beaten force. They feel that a treaty made when they were vanquished ought to be revised now, when they are powerful and prosperous again. And the federated employers have from time to time listened to and discussed their proposals for revision. And now, after ten years, has just been drawn up and provisionally signed by the respective executive bodies, a new "agreement between the Engineering Employers' Federation and the engineering trade unions as to working conditions and avoidance of disputes." The enginering trade unions are the A. S. E. (the Amalgamated Society of Engineers), the Steam Engine Makers' Society, and the United Machine Workers' Association. The agreement is signed by the chairmen and secretaries of these societies and by the chairman and secretary of the Engineering Employers' Federation, subject to formal ratification by the constituent bodies.

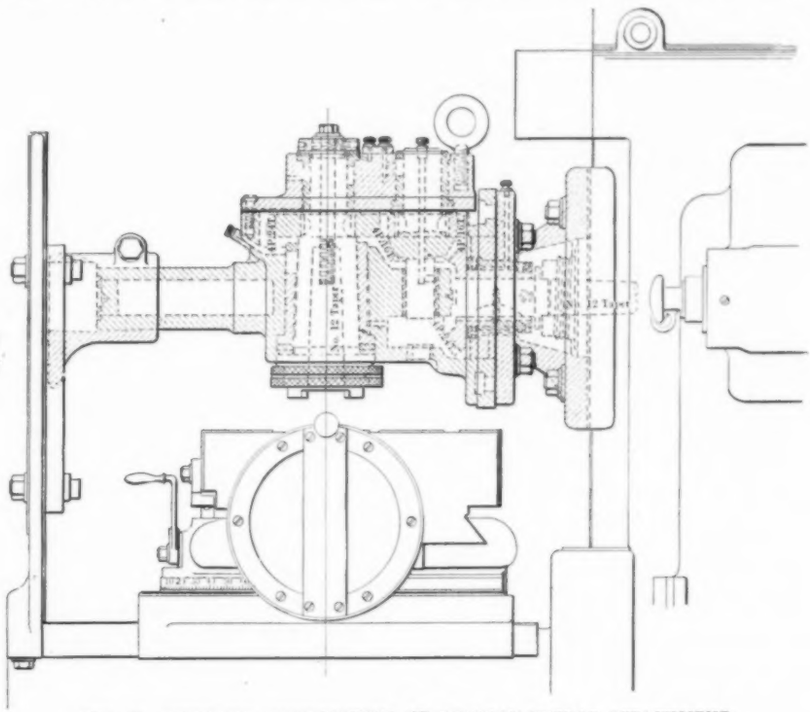


FIG. 7. SHOWING CONSTRUCTION OF VERTICAL SPINDLE ATTACHMENT

Terms of the Agreement

It is doubtful if, in all our industrial affairs, a more comprehensive and fair-minded document was ever evolved. Its principle is justice, and its essence is what, in trade-union phraseology is called "mutuality." It is the product of mutual respect engendered in the long term of peace since one of the most severe industrial wars on record. Here, for instance, is the note as sounded in the preamble:

"The representatives of the Engineering Employers' Federation on the one hand and of the engineering trade unions on the other hand being met in joint conference, and, being convinced that the interests of each will be best served and the rights of each best maintained by a mutual agreement, hereby decide to adopt measures to avoid friction and stoppage of work."

This, it will be observed, implies a permanent abolition of the militant element. This was, in effect, the note of the 1898 agreement also, but that agreement has been associated in the minds of the men with the surrender of the vanquished, whereas the present agreement is between two powerful bodies fully equipped for both good and evil. The difference is material, and this is what lends a national and even a world-wide interest to the new treaty. It provides for the effective recognition of trade unions and also of non-union labor.

General Principles of Employment

"(1) The federated employers shall not interfere with the proper functions of the trade unions, and the trade unions shall not interfere with the employers in the management of their business."

The position of the trade unions is thus assured and their "proper" authority is established. They can therefore now afford to recognize what they have sometimes attempted to ignore or destroy—freedom of employment and freedom of labor—in other words, the liberty of the subject. The conditions of employment are further laid down in another clause.

Employment of Workmen

"(2) Every employer may belong to the federation and every workman may belong to a trade union or not, as either of them may think fit. Every employer may employ any man, and every workman may take employment with any employer, whether the workman or the employer belong or not to a trade union or to the federation respectively. The trade unions recommend all their members not to object to work with non-union workmen, and the federation recommend all their members not to object to employ union workmen on the ground that they are members of a trade union. No workman shall be required to make a declaration as to whether he belongs to a trade union or not."

There is greater concession involved in this clause than may appear to the outsider, but the concession is on both sides. Among some employers there has been a very strong objection to the employment of trade-union workmen, however good, because of their subservience to trade-union tactics even when their own re-

*From the Financial and Commmercial Supplement of the London *Times*.

lations with their employers are harmonious, but the federation of employers are now to agree that trade unionism shall be no bar to employment in any workshop. And *per contra* the trade unions will not allow their members to make trouble by refusing to work alongside non-unionists. The principle of this clause was embodied in the 1898 agreement. It is no new thing, but it has acquired additional importance now, when after ten years' experience the trade unions formally admit the rights of non-union workmen.

Then, again, trade-union rights to collective bargaining are established in Clause 5, while the right of employers to elect and rate workmen according to their ability or industry, and not merely according to dead-level scale, is also established. Thus:

Rating of Skilled Workmen

"(5) Employers have the right to employ workmen at rates of wages mutually satisfactory to the employer and the workman or workmen concerned. In fixing the rates of skilled workmen the employer shall have regard to the rates prevailing in the district for fully trained and skilled men. Unions, while disclaiming any right to interfere with the wages of workmen other than their own members, have the right in their collective capacity to arrange the rate of wages at which their members may accept work. General alterations in the rates of wages in any district shall be negotiated between the employers' local association and the local representatives of the trade union or unions concerned."

Machine Tools

Peculiar interest attaches to Clause 7, which runs thus:

"(7) Selection, training and employment of operatives and manning of machine tools:

"Employers have the right to select, train, and employ those whom they consider best adapted to the various operations carried on in their workshops, and to pay them according to their ability as workmen. Employers, in view of the necessity of obtaining the most economical production, whether by skilled or unskilled workmen, have full discretion to appoint the men they consider suitable to work all their machine tools, and to determine the conditions under which they shall be worked. The federation recommend their members that, when they are carrying out changes in their workshops which will result in displacement of labor, consideration should be given to the case of the workmen who may be displaced, with a view, if possible, of retaining their services on the work affected or finding other employment for them."

The importance of this clause will be apparent to those who recall the heated controversy over what was called the "machine question" before the strike of 1897. The operatives of the A. S. E. claimed that all machine tools, even those which can be efficiently tended by ordinary laborers, should be allotted to engineers at full engineer's pay, while the employers contended that they should select and train any men they liked for such non-technical work. Moreover, machine workers have a society of their own, though it now operates in alliance with the A. S.E. The effect of the above clause is to accord the employers the freedom which they claimed, but they in turn agree to give special consideration to the case of workmen displaced by the adoption of machine tools. This is a reasonable provision, and, as a matter of fact, it is only in accordance with general practice. Few employers have allowed skilled men to be (as the Americans say) "scrapped" for the sake of a new tool. And few skilled operatives of the engineering class would be content to turn the handle of a machine for the rest of their lives even for the rate of pay accorded to experienced artisans. Some machine tools, of course, require skilled men to look after them, but any ordinary boy or man can be quickly trained to tend an ordinary machine.

Overtime and Piece Work

Overtime is always more or less a sore question in trade-union circles, and it has been a particularly sore one in the engineering trades. The trade unions have now persuaded the federated employers (and no rational employer favors overtime as a regular practice) to agree to discourage overtime, and that no union workman shall be required to work more than 32 hours' overtime in any four weeks, unless in cases of urgency and emergency, such as "breakdown work, repairs, replacements or alterations for the employers or their customers, trial trips of or repairs to ships."

Another vexed question has always been that of piece work, which the trade unions generally dislike as societies, but which skilled artisans like as individuals. What the employers secured under the 1898 agreement was that the rates for piece work should be settled by mutual arrangement between the employers and the workmen, and this condition has worked well. But now the trade unions have secured from the federated employers the concession that no man on piece work and at the piece-work rates shall earn less than the day's rate he would earn if he were working on time wages. Overtime allowances are also conceded on piece-work prices.

There was a disposition on the part of the operatives to restrict the number of apprentices allowed into the trade to a fixed proportion of the journeymen. The trade unions have, however, not insisted upon a fixed proportion, but have accepted the following clause:

Apprentices

"(6) There shall be no recognized proportion of apprentices to journeymen, but it shall be open to the unionists to bring forward for discussion the proportion of apprentices generally employed in the whole federated area. An apprentice shall be afforded facilities for acquiring a practical knowledge of the branch of trade he adopts, and shall be encouraged to obtain a theoretical knowledge thereof as far as circumstances permit."

Here is no arbitrary restriction, but mutual provision for reasonable regulation and development.

Provision for Avoiding Disputes

From the point of view of the industrial peacemaker, the following provision is the most important of all:

"(8) With a view to avoid disputes, deputations of workmen shall be received by their employers, by appointment, for mutual discussion of any question in the settlement of which both parties are directly concerned; or it shall be competent for an official of the trade union to approach the local secretary of the Employers' Association with regard to any question; or it shall be competent for either party to bring the question before a local conference to be held between the local association of employers and the local representatives of the trade unions. In the event of either party desiring to raise any question, a local conference for this purpose may be arranged by application to the secretary of the Employers' Association, or of the trade union concerned, as the case may be. Local conferences shall be held within twelve working days from the receipt of the application by the secretary of the Employers' Association, or of the trade union or trade unions concerned. Central conferences shall be held at the earliest date which can be conveniently arranged by the secretaries of the federation and of the trade union or trade unions concerned. There shall be no stoppage of work either of a partial or of a general character, but work shall proceed under the current conditions until the procedure provided for above has been carried through."

This is the 1898 provision more clearly defined and confirmed, and accepted by both parties after the experience of ten years. The settlement of disputes is not left to the brute force of strikes, but the diplomacy and judgment of other members of the trade.

Constitution of Conferences

Thus the conferences are to be composed as under:

"An organizing delegate of the Amalgamated Society of Engineers shall be recognized as a local official entitled to take part in any local conference, but only in his own division. In case of sickness his place shall be taken by a substitute

appointed by the executive council. Any member of the executive council, or the general secretary of the Amalgamated Society of Engineers, may attend local conferences, provided that the member of the executive council shall attend only such conferences as are held within the division represented by him. A member of the executive council or the general secretary of the Steam Engine Workers' Society and of the United Machine Workers' Association respectively, may attend any local conference in which the societies, or either of them, are directly concerned. Central conferences shall be composed of members of the executive board of the federation and members of the central authority of the trade union or trade unions concerned. An employer who refuses to employ trade unionists will not be eligible to sit in conferences."

Here, again, the trade unions have the amplest recognition of their administrative and coöperative functions. They are in the position of high contracting parties to a treaty which reflects credit on the reason and good sense of those who have drafted it, and which may well stand as a pattern to the whole industrial world.

Eating Lead Pipe

Electrical engineers and fire underwriters interested in the Union Stock Yards have become alarmed over the advent of unidentified larvæ which are swarming in certain sections of the packing plants and insisting upon feeding on the lead-pipe insulation of electric wires. These brown, hairy little wigglers, each five-eighths of an inch long, are moving through the "hoof" houses at the yards, gnawing irregular patches of lead, and often cutting through the cloth and rubber insulation and short-circuiting the electric current. Holes an inch long and half an inch wide have been cut through one-tenth inch thickness of lead pipe. "The lead-pipe cinch" bug is the designation given the creature by Director Skiff, of the Field Columbian Museum, in whose entomological laboratory this little lead eater is under observation.

A Little about Brazing

By J. H. Bain

In brazing solid ends in tubes and similar work there are a few points to be remembered. Of first importance is venting. Whether borax or boric acid is used as a flux, gases are thrown off, and the water in the borax or boric acid and in the damp tube forms steam; a vent or vents must be made to allow the escape of the steam and other gases.

We will take as an example the job shown at Fig. 1, in which *A* is the tube and *C* the two solid ends to be brazed in. Of course, one end could be fitted and brazed in first, then the other could be fitted and a small vent hole drilled at *D*. Next, the charge of flux and spelter for the last is put in, the end fitted in, pinned in position and then brazed with the first end uppermost, which would allow the charge of flux and brass to rest on the lower end. When the melted spelter shows around the outside, the job is ready to remove from the fire. While this last braze is being made, the steam and gas blow through the vent *D*.

It is, however, often far handier to do all the fitting up and pinning at once. Fig. 2 shows a job that would be better done in this way. In this case the job is rectangular. The four solid corners *A* are connected by four pieces of tubing; the corners are all fitted and drilled ready for pinning. Before pinning, a loosely crushed wad of paper *C* is pushed into about the center of each of the tubes. A charge *D* of flux and spelter is put in, and the corner fitted in place and pinned. The wads of paper *C* prevent the spelter required for both ends of the tube from mixing and running all to one end, leaving nothing for the second braze on the tube. A vent hole is drilled at *BBBB*. The paper being packed close enough to prevent the charge of brazing material at one end of the tube from mixing with that at the other end, but not close enough to prevent the gases from escaping through the vent holes *BBBB*. Often after a braze of this kind is finished, some pieces of scale or brass or borax are loose inside the tube and rattle about. Some brazers try to braze these in place. This is all wrong, difficult to do, and liable to burn the tube. A little powdered rosin put in through the vent hole and melted with gentle heat when inside, will stick the loose pieces inside and prevent the rattling, or a little varnish will serve the same purpose. The job would be put in the forge as at Fig. 3, thus brazing both tubes into the corner at the one heat.

Occasionally it is desired to braze a drill, reamer or tap on to a long shank. Any sort of joint will do, say like Fig. 4 or Fig. 5. The joints may be either pinned or wrapped with wire. After pinning, the tap should be pushed into a large juicy potato, as shown at *A*, Fig. 6, or it may be wrapped with wet waste. A washer of asbestos millboard, as shown at *B*, Fig. 6, should be placed as shown, to take the fiercest of the flame. For a job of this character a gas blowpipe gives the best results, and is far easier to handle. The tempered part, being imbedded in a wet substance, is protected, and the braze can be made without any fear of drawing the temper of the tap or reamer. In heating, as the heat can do no harm to the shank, it is best to heat from the shank end.

There are said to be methods whereby brazing can be done without heat, by chemicals. Don't touch them, unless you see them demonstrated. I have tried several of them, but never with success. A good method of cold brazing would be very useful for many jobs, such as brazing patterns to a gate, as shown at Fig. 7. But there is, so far, no cold method known to me. I have therefore had to content myself with a hot method which is fairly simple and produces good results if carefully done. The pattern for the gate proper and the various patterns which are to be attached to it are made. The patterns are dressed up and fitted to the gate. The gate and patterns are then bedded to the correct depth in a bed of clay in a shallow box, preferably of sheet iron. The box, with the patterns still embedded in the clay, is then put into an oven and dried at an even temperature. When the clay is dry, the patterns can be brazed to the gate without any fear of

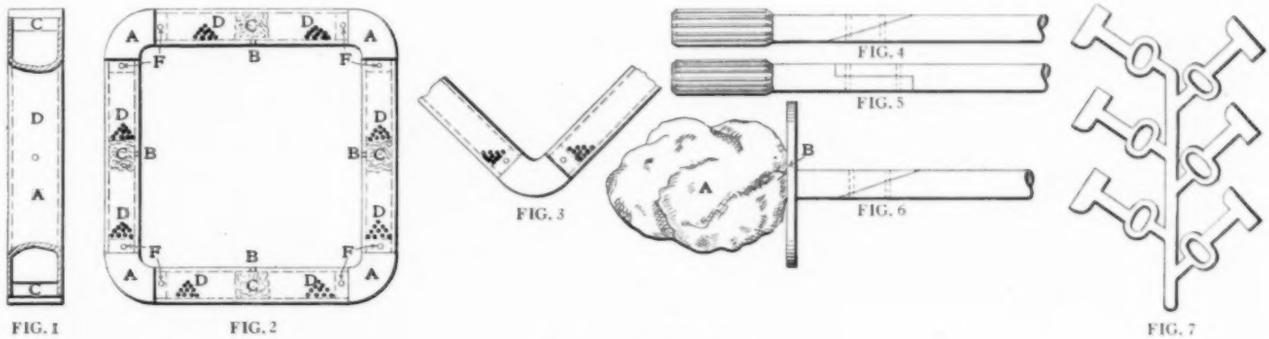


FIG. 1 FIG. 2

SOME BRAZING KINKS

their shifting and breaking off while another braze is being made on the same gate. Asbestos, asbestos and clay, asbestos and ashes or asbestos and plaster-of-paris may be substituted for clay, but it must be remembered that plaster-of-paris requires very long baking to dry it. I have known of molds, about 8x8x2 inches, made of plaster-of-paris, clay and asbestos, being in a drying oven for two weeks without becoming perfectly dry. Any part of the work where the spelter is liable to run and where it is not wanted may be protected by painting it with black lead and water.

It is hardly necessary to state that the spelter used must be suitable for the work, that is to say, it must have a lower melting point than the metal for which it is used. Borax as a flux is improved by burning or melting it in a crucible. The crucible should be of earthenware, as flakes of graphite are liable to mix with the borax if it is melted in a graphite crucible. They do not improve the flux. To properly burn borax it should be thoroughly melted, then poured out on a clean iron plate or stone. When cold it can be powdered to any degree of fineness in a mortar. Never buy so-called ready-made burnt borax, as it is very often not properly calcined.

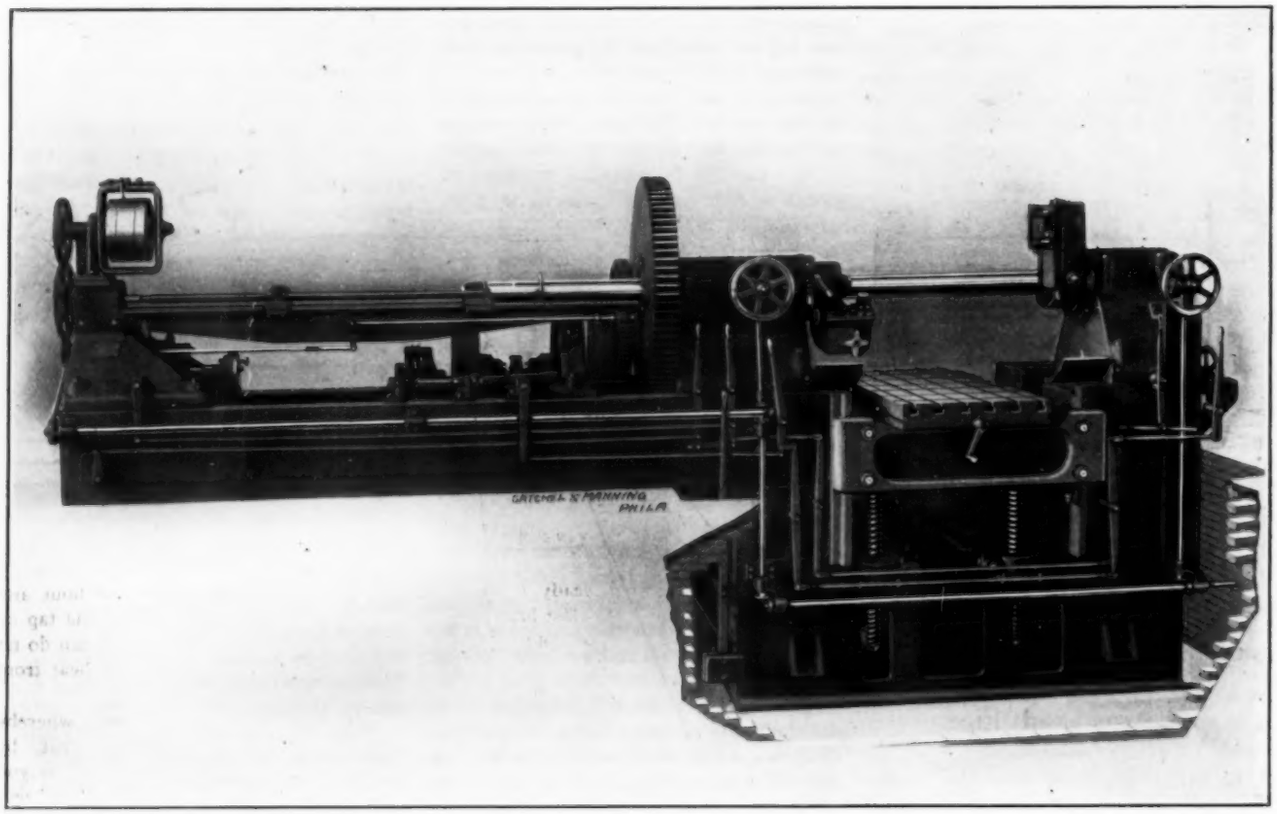
In conclusion, remember to keep the work clean; no grease, rust nor dirt where the braze is to be made; use plenty of flux, and in most cases do not be afraid to use plenty of spelter.

22x40-inch Locomotive-cylinder Boring Machine with Adjustable Table

The half-tone illustrates a machine designed especially to bore and face locomotive cylinders having cylindrical valves. As will be observed, this machine is provided with a single boring bar and has an adjustable table by means of which each center can be successively brought to the bar and the work expeditiously proceeded with. This single-bar feature, providing for the boring of one hole at a time, permits the use of driving gearing of large diameter and with ample power for maximum requirements, thus avoiding the restriction as to gear sizes due to the minimum center distances required for small cylinders where two bars are used simultaneously. It also insures smooth, accurate work in the cylinder bore and makes it practicable to employ effective slide rests for facing the cylinder ends.

In the machine illustrated, ample power is provided for the heaviest practicable cuts, and care has been taken to make the various movements convenient to the operator; a double set of levers and hand wheels is provided, so that the movements can be controlled from either head, as may be most convenient at the time.

A steel boring bar 6 inches in diameter passes through a sleeve in the driving head, and is driven through two keys diametrically opposite each other to balance the strain. The sleeve is rotated by a large spur wheel driven through suitable reducing gears from a clutch shaft which is driven by belts from a counter-shaft actuated by a 20 horse-power motor. The bar is fed forward by a 2¼-inch screw through a geared feed motion, and is provided with a rapid power traverse for quick movement into position. In setting work, the bar is withdrawn from the outboard head, the cylinder lowered in position, secured to the table, and the bar run forward until it engages the sleeve in the outboard head. This head is adjustable along the bed of the machine to suit the length of the cylinder. Each of the sleeves carries a substantial facing rest, which is so made that when not in use it hangs suspended in a vertical position. When it is desired to use the facing rests, a convenient lever clamps them to their respective flanges, and they rotate with the sleeves as long as required. The boring cutters are secured in a suitable head on the bar, not indicated in the illustration. These heads are changeable to suit the different diameters of cylinders. The slotted work table is 7 feet long; it is carried by four 4-inch screws operated by power for raising and lowering the table; it has a vertical adjustment of 24 inches, from a minimum distance of 20 inches below the center of the bar to 44 inches. The sliding head carrying the work table is provided with powerful clamps operated from the work-



22X40-INCH LOCOMOTIVE-CYLINDER BORING MACHINE

ing side or front of the machine, for securing it rigidly to the bed in any desired position. The top table has a transverse motion by screw of 16 inches on each side of the center. An automatic stop motion is provided to disengage the feed when the limit of travel of the bar has been reached. Small adjustments of the bar are made by the hand wheels shown on the heads. The traverse of the bar is 9 feet 4 inches. The machine is stopped instantly by friction clutches and a powerful brake. The bed is 41 inches wide by 21 inches deep throughout its upper part, and extends down in the foundations so as to afford a suitable base for the elevating table, and to tie the two ends together.

The machine weighs about 57,300 pounds. The builders are William Sellers & Co., Inc., Philadelphia, Pennsylvania.

A Square-deal Premium System

By Daniels

I do not wish to make any pretensions to being an expert along these lines, but I have had a varied experience in a number of machine shops, and under some very discouraging conditions. In some shops things ran in a "rolling off the log" sort of way, where troubles were the exception rather than the rule.

I have sometimes been tempted to believe that some so called premium systems do not produce the results that are sometimes looked for or that could reasonably be expected from them. In fact some are not premium systems at all, but simply an old piece-work system with the rust and grime accumulation of years rubbed off and a coat of paint put on, named "premium," and started off, with the results to be obtained a secondary consideration.

Harmony Pays Anywhere

I think it is a generally admitted fact that in the successful operation of shops today one of the most important factors is a feeling of harmony and good will among employees, and between them and the management; and that nothing will disturb this quicker than a change of policy along the lines of piece work or premium; either the changes on an old system or the installation of a new one.

The first thing necessary for the operation of a premium system is the determination of the time in which an operation on any part could reasonably be expected to be performed. If a good time-keeping system is used and operations have been properly tabulated and recorded, we can get a fair idea of values; but this should not be relied on entirely, since in many cases a little observation will show that some operatives are not producing a fair day's work.

But in setting rates, care should be taken not to go too far above normal production, since the operator knows just what he has been producing and you make him feel that you are crowding him, or that you want whole hog or none. Another reason is that should he fall in with your plan, the increased earnings would be so small that he would soon lose interest, or in other words, the premium would not be worth the effort.

Juggling the Rates

After getting prices or rates set on certain jobs, many cannot let them alone, but must keep nibbling at them; or as soon as the operator's earnings go beyond a certain figure, cut the rate.

This is sometimes done without the operator's knowledge, and at the end of the pay period he finds his envelop short. On inquiry he is told the price has been cut. What can be more discouraging to a man after a week or two of hard effort, thinking his earnings are a certain amount, than to find that someone has arbitrarily taken 10 or 15 per cent. of it without his knowledge? Or, in other words, after agreeing to pay a certain price for the only commodity the worker has to sell and having the goods delivered a lower rate is offered.

This price-cutting is also an almost positive throttling of production within a certain limit. We find among employees an expression like this: "At So and So shops they allow you to make so much." Now, why is this? Simply because employees soon determine the limits within which they are safe from a cut, and act accordingly. The writer has known many cases where these conditions prevailed where an operator, by force of circumstances, has gone over his daily production and, rather than risk a cut, sacrificed the value of the extra work to avoid not only a cut but the condemnation of his fellow workmen, who would in turn suffer for his folly.

Setting New Rates

I find there is a tendency in setting new rates or prices to base them, not on what was considered a fair standard of production, but at what has been arrived at on a premium-paying basis. For example, assume that for turning machine-steel shafts and rods, we arrive at a certain number of feet per minute surface-cutting speed for finished work. On a premium basis this has been increased 25 or 50 per cent. On any new work this increased cutting speed is used in prices or rate-setting, and it becomes equivalent to a cut. The operator will be the first to notice it, and he immediately loses confidence in the system; the ultimate result will be that the system will die out for lack of profit to the operator.

We will, of course, admit that no man is infallible, and in this rate-setting I believe there is more room for error than in any other department in a shop. But then it is also evident that errors are made both ways. Some will be too close and others too wide; some may look like a loss to the company by excessive rates and prices. Assuming that there are some both ways, why not go directly to the operator and make an adjustment that would be fair to him and also to the company?

Adjusting Rates with the Men

I have many times made adjustments of this kind, and nearly always gained my point, and at the same time gained the operator's confidence and interest by making him feel that he was going to get a square deal. In the majority of such cases I have found that the production increased on these machines.

This may sound impractical and poor policy to some, but my experience has been that 90 per cent. of the men in the trades are honest and that better results can be had from them by applying the golden rule and making them feel that their interests, as well as the company's, are being looked after. There is only one way to get out of any man the most that is in him, and that is to place no limit on his earnings, either directly or indirectly, any more than you would on his production.

Manufacturers should pay a little more attention to this end of their system, and not expect overworked foremen to look after it for them. They should get good practical men to attend to all the details. By a practical man I do not mean a $12 a week clerk, who does not know the difference between a monkey-wrench and a steam cylinder, but one who can analyze operations, can determine the producing power of machines, and make a proper application of them. Then I am sure there would not be a premium system in the country that would not be giving the best results

[A policy of rate-cutting will destroy the efficiency of any premium system, and it was the inherent tendency to such cutting as part of the piece-work system that led to the invention of the premium plan. All this has been explained in these columns repeatedly, but the effect of rate-cutting, as described by our correspondent, cannot be repeated too many times. —Ed.]

Kerosene is still a large factor in the world of artificial illumination, and the candle is not extinct. The bureau of manufactures in the Department of Commerce and Labor reports that this country has an export trade in candles worth about $700,000 a year, or more than it exports of incandescent lamps. But Great Britain did an export trade in candles of $3,178,000 and France in 1904 shipped out $1,218,500. The chief markets, apparently, are the Cape of Good Hope, Natal, Portuguese East Africa, Morocco, China and Chili. Africa is the largest consumer.

Molding Six Worms at Once

By G. Ray

The article at page 550, in regard to making four worms on a molding machine, reminds me of a proposition I had some years ago. We had taken an order for gray-iron worms, intending to mold them on a match board. The results were not all that could be desired, and our customer refused to accept the worms. So it was up to us to devise some other means of molding.

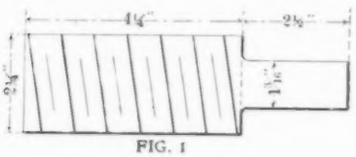


FIG. 1

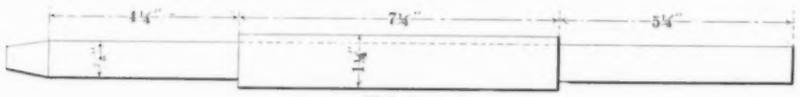


FIG. 2

THE WORM AND THE SPINDLE

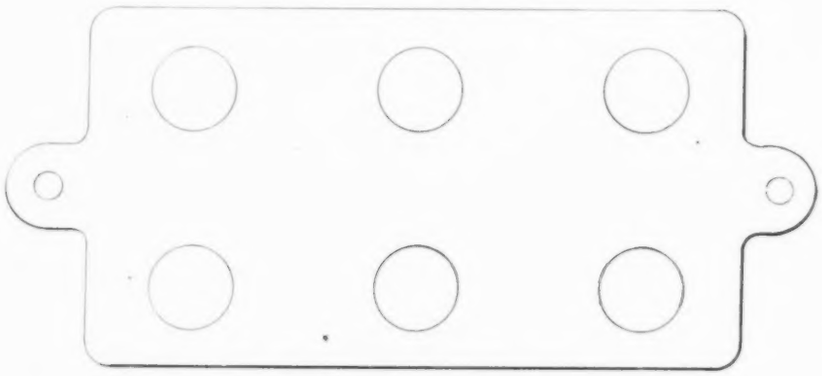


FIG. 3. THE STRIPPING PLATE

The following illustrations will show how we overcame the difficulty, by molding six worms at once, screwing them out of the sand.

Fig. 1 shows the pattern to be molded. This was cut in two, at *A*, shown by the dotted line, and the shanks were molded on a stripping-plate machine.

Fig. 2 shows the shafts, six in number, with core prints at the top. Twelve worms were cut, of which six were mounted on the top of the shaft (Fig. 2) and six on the bottom, those on the bottom of the shaft being somewhat longer, for reasons which will appear later.

Fig. 3 is the top view of the stripping plate, showing the position of the worms, which gives the molder plenty of room to tuck the sand.

The Gears Used

Fig. 4 gives the top view of the gear box, in which are eight gears of eighteen teeth, six pitch, and one gear of thirty teeth, six pitch. The six gears marked *A* are bored a sliding fit to the shaft (Fig. 2), and have keys dovetailed in them, as at *B*, which slide in the keyways of the shaft. The two gears marked *C* serve as a drive for the last two gears in the train and also correct the direction of rotation of the worm. This gear box is made of two sections, fastened together with machine screws, and is bored to form a bearing for the worm shafts. This preserves perfect alinement and prevents the worms from wabbling, should the nuts become worn.

In Fig. 5 we have a sketch of the machine assembled, the worms being omitted so as to give a better view of the stripping plate and nuts. *D D* are two bevel gears, one being fastened to the same shaft as the big gear in the gear box, the other mounted on a shaft *E*. It runs in bearings *F F*, which are located in the correct position, so that the two gears will mesh properly. This shaft is rotated by handle *G*, forming the drive of the machine. *H* shows the guide plate for the lower worm, the nuts being much thicker than those in the stripping plate. These nuts, as well as those in the stripping plate, are of babbitt, and are poured after the machine is assembled, the worms being then taken out, and the nuts relieved until they work freely.

Why the Lower Worms Are Longer

The lower worms are arranged so that they stay in the nuts when the upper ones are clear of the stripping plate, thus allowing the latter to be removed. Stops are provided on the frame of the machine, so that the hight of the worms above the stripping plate may be easily regulated.

The stripping plate is fastened to the frame of the machine by flat-headed machine screws, as also are the gear box and lower plate. The guide plate *H* is fastened on the lower side of the lugs, so that it may be easily removed.

It will be observed that the parting line is not straight, but, starting in on a level with the top of the plate, follows the pitch of the worm three-quarters of a turn. This does not leave any sharp corner in which the molder must tuck sand, and lessens the liability of loss of castings due to the molds washing.

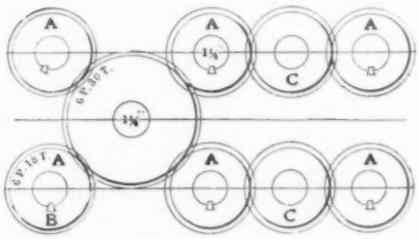


FIG. 4. GEARING OF THE MOLDING MACHINE

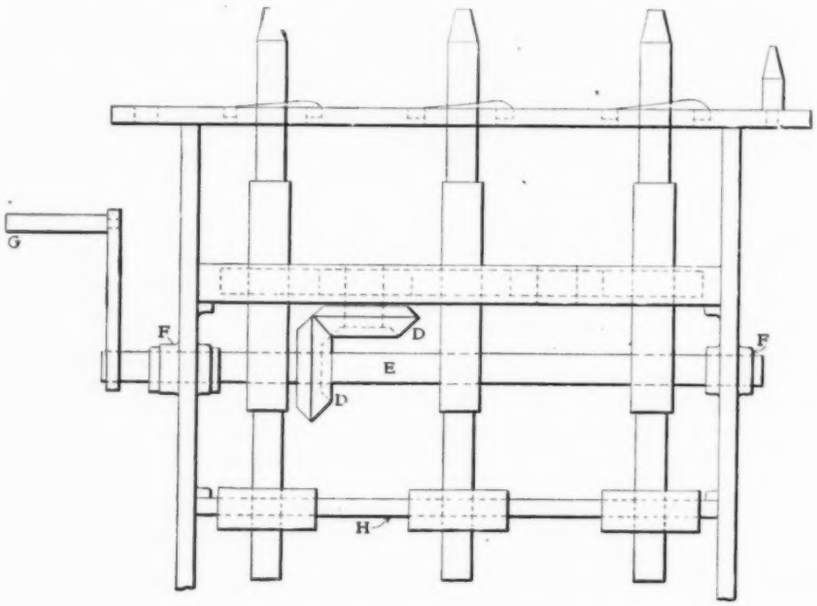


FIG. 5. THE MOLDING MACHINE

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Automatic Releasing Air Clutch

In 1905 I had to design an automatic machine, the main part of which was belt driven, and some auxiliary motions of which were performed by the aid of compressed air-operating pistons through piston valves, the latter actuated by small cams.

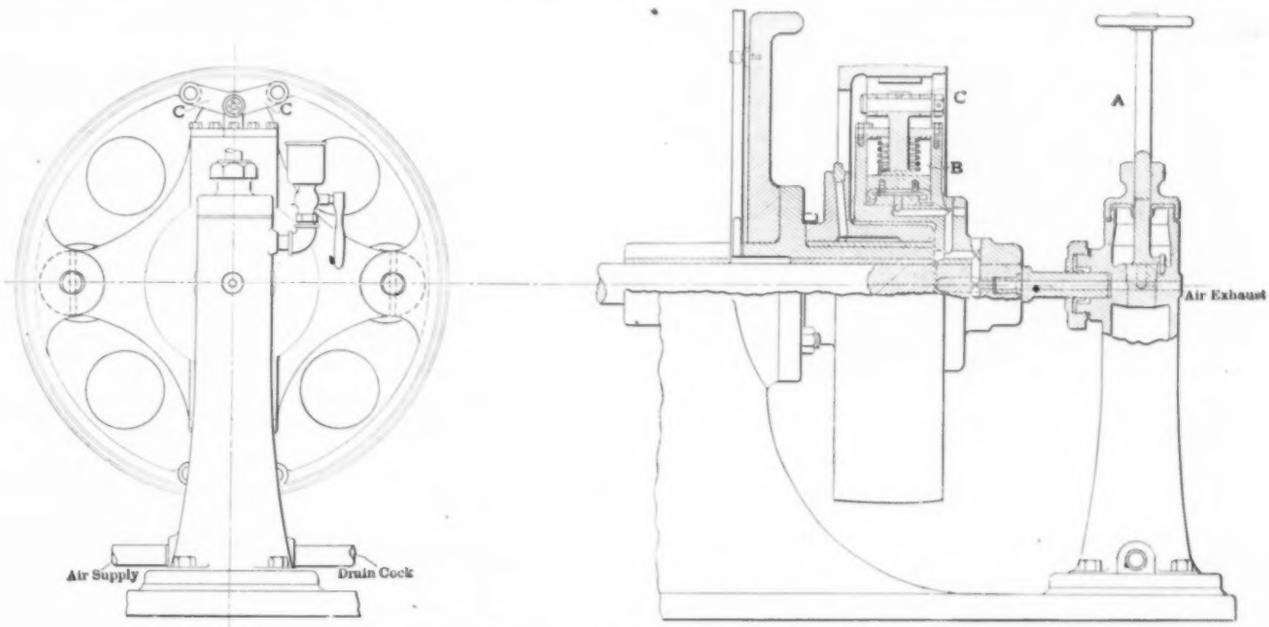
It will be readily conceived that should the air pressure fail, thereby stopping the motions it controls, while the main part of the machine keeps on moving, interference must eventually take place, and a "smash-up" result. To avoid any damage being done to the machine, it must stop as soon as the air pressure fails.

To arrive at this, several ways presented themselves; but none seemed to be as promising as what I would call an auto-release pneumatic clutch, shown on accompanying drawing, which was adopted and proved to be a success. I will try to explain briefly how the clutch operates.

The throttle valve *A* being turned to the left, air is admitted under pistons *B*, which, through toggles *C*, apply shoes which stay clutched to the pulley as long as the air pressure remains sufficiently high. When the pressure fails, the friction shoes are immediately released by the springs, which have been made strong enough to overcome all frictional resistances and centrifugal force. The shoes being released, the machine stops.

It is obvious that the clutch can be operated from any distance, and it may have a great advantage over purely mechanical clutches, as it is self-adjusting. I have not altogether run away with the idea that the application is new, but I thought that it might be of interest to your readers.

J. A. G. GOULET.



DETAILS OF AUTOMATIC RELEASING AIR CLUTCH

A Queer Standard Screw

There has been much written about the gap existing between the teaching of the ordinary elementary school and the requirements of actual working life, but during the last few years this gap to a great extent has been filled up by the technical school. The teaching there given is generally correct and reliable, but there creep in at times ridiculous mistakes.

I attended a lecture on screw threads at a large technical school in the west of England. The lecturer was the head master of the school and an A. R. C. Sc. After giving the history of the screw thread and enumerating the different kinds, he went into details, taking first the Whitworth thread. He informed us that Whitworth first turned his stock to standard size, then turned the thread to a sharp point and finished off with a chaser which took off 0.16 of the pitch to form the radius. Thus on the diameter the reduction would be 0.16×2, which is 0.32. This was another way of saying that an inch tap, for instance, would measure 1 inch — 0.32 of the pitch.

Thinking that perhaps I had misunderstood him, I ventured to inquire if what I had gathered from his lecture was correct. "Oh, yes. Why?" I explained that all taps were made a definite standard size, that a 1-inch tap measured 1 inch. "Oh, yes," he replied, "you may have thought so, but the difference is so slight you would need an instrument called the micrometer—which you may have heard about—to detect it." The difference, according to his reckoning, was only 0.04. He proceeded to explain what a micrometer was; how delicately it measured sizes up to thousandths, etc., etc. Of course, this instrument was only used in the laboratory, nothing being done in the workshop requiring its use.

This was too much. Up jumped a fellow, with a set of feelers in his hand. Selecting the 0.002 feeler he asked the lecturer if he had ever seen anything like that before, and further would he believe that in his tool cupboard at the shop there is a *mike* that can be set to a ten-thousandth part of an inch, and what's more, it is used every day. The lecturer collapsed at once, he "really wasn't aware that these instruments were in common use. He must look it up."

What he wanted to tell us was this: If the thread was made sharp at top and bottom, the depth would be 0.96 of the pitch, but allowing 0.16 of the pitch, or 1/6 of the total depth, for the radius at top and bottom, the actual depth is 0.64 of the pitch, or 2/3 of the total depth.

L——, England. A Mere Turner.

A Drilling Jig

In a class of work a few samples of which are shown by the sketches Figs. 1, 2 and 3, the two holes *a* and *b* were formerly drilled by means of jigs shown by Figs. 4 and 5, which, as may be imagined, were not prize winners in jig design.

The Original Jigs

The jig in Fig. 4 was the one causing most trouble, and it was to replace this that the new jig was gotten up. The work was inserted in the jig, being located by the diameter *c*, Fig. 2, fitting into a recess in the jig, and then a screwdriver was used to clamp the work by means of the screw below. The price was high and the production small, and the job was considered a poor one by the operators. The practice was to drill the small hole, 1/4-inch diameter, first, and then insert a pin to keep the work from turning while the large hole, 23/64-inch, was drilled.

The jig, Fig. 5, may be described as a sort of built-up frame about as shown by sketch. The work, a brass casting Fig. 1, which had previously been turned to size at diameter *c*, was placed with this part in the recess of the jig, located against the pin *a*, and the wedge *d* inserted and driven up with a hammer.

The jigs, Figs. 4 and 5, were used on a two-spindle drill press under each spindle of which was bolted a plate having a slot in which the jig was placed to prevent its turning.

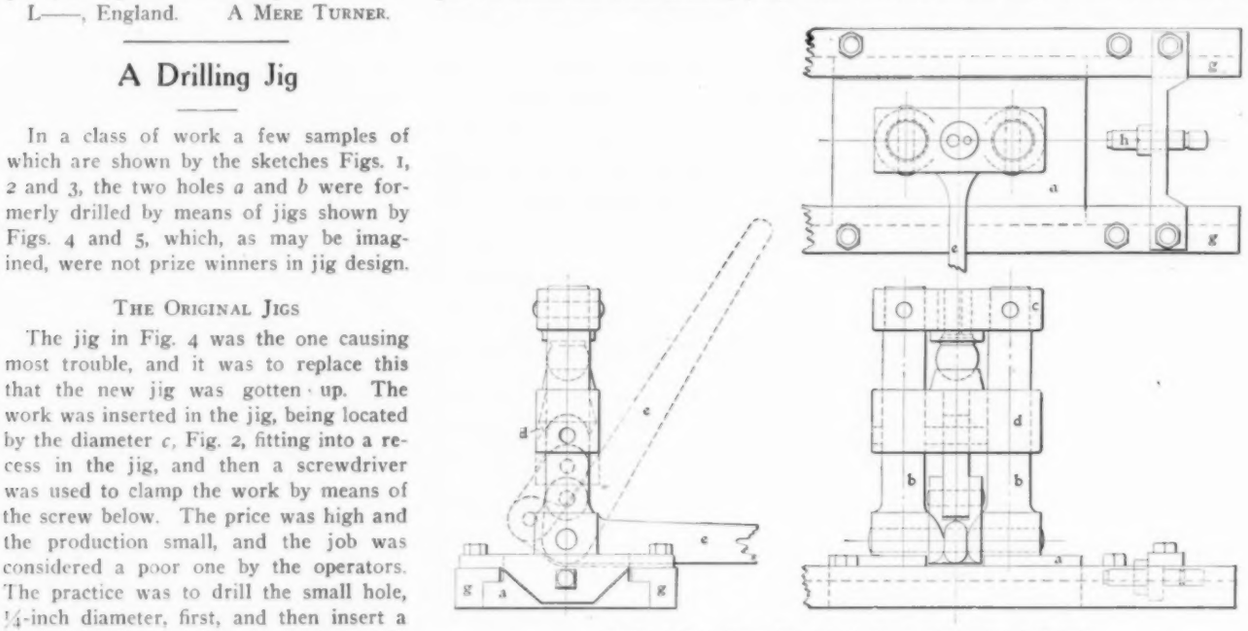


FIG. 6 The New Jig, as at first made with a Toggle.

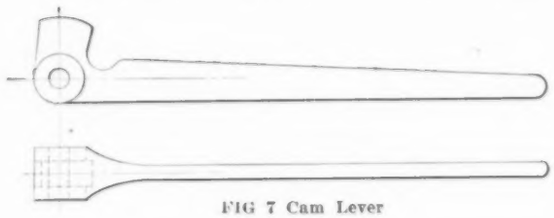


FIG 7 Cam Lever

A DRILLING JIG

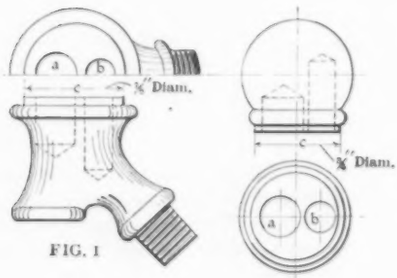


FIG. 1

FIG 2

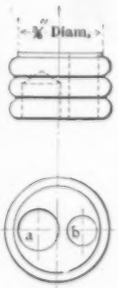


FIG. 3

Examples of the Work to be Drilled.

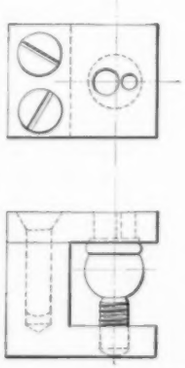


FIG. 4

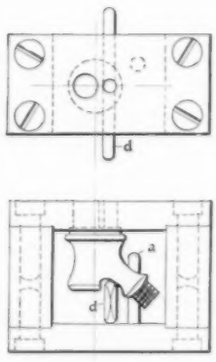


FIG. 5

The Jigs which were Superseded.

A DRILLING JIG

Fig. 6 shows the jig that replaced the old ones and shows it as first made. It has a base *a* into which are screwed the two posts *b b*, the tops of which are bound together by the yoke *c*, which is pinned to the posts. The piece *d* is raised and lowered by the lever *e* and toggle joint.

Yoke *c* holds the drill bushing, and piece *d* holds the work-holding plug, each of which may be changed for different jobs.

The New Jig, First Made with a Toggle

The guides *g g* were bolted to the drill-press table, and at each end was an adjustable stop *h*. Later on the jig with the guides and stops was mounted on a base plate of its own, and the guides doweled on. The whole was held on the drill-press table by clamps. This saved much time in setting up and assured the guides being properly set at all times.

In operation the work is put into its seat and is quickly clamped by the lever and toggle. It is drilled at whichever end of the table it happens to be, then moved to the stop at the other end, and the second hole drilled. On the back side of the table at each end are chutes leading to a work-box on the floor, and the work when released is simply pushed out behind and finds its way to the box.

The Toggle Replaced by a Cam

The toggle joint worked very well on the turned work, Figs. 2 and 3, and simi-

lar pieces, in which the variation in length was very slight; but it was not possible to hold castings such as Fig. 1, owing to the differences in length.

Accordingly the lever and toggle were replaced by the cam lever, Fig. 7, and a roll held by a bracket fastened to the under side of piece *d*. This completed the jig as finally used, and gave very satisfactory results.

The Reduction in Cost by the Use of the New Jig

It might be mentioned that with the new jig the cost of drilling castings like Fig. 1 was reduced about 35 per cent., and as that job alone came along in 8- and 10-barrel lots the jig was a good investment. The cost of eight or ten other pieces which went into this jig was reduced in like manner.

The jig is obviously adaptable to any piece of turned or cast work, within certain limits of size, which requires either one or two holes to be drilled.

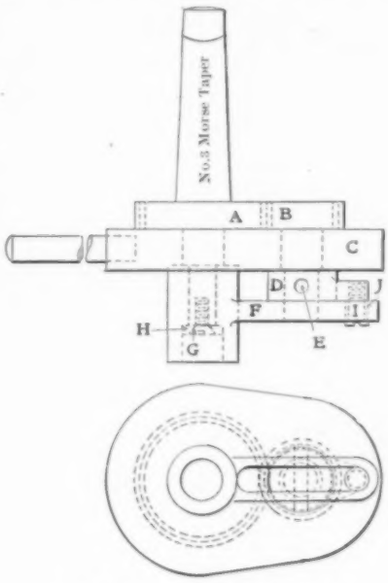
Raymond Grant.

Grinder for Valves in Automobile Engines

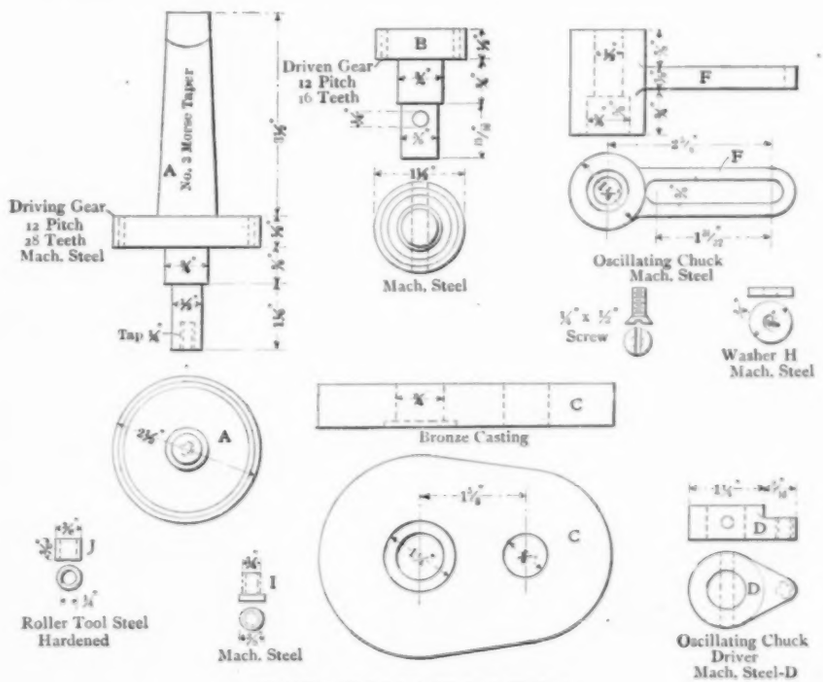
Inclosed you will find drawing of a device for grinding in valves for gas engines in automobile work. My claim for it is that it will do the work of six men grinding by hand, and that it does the work more accurately.

It is operated in a drill press, and has a rapid oscillating motion, which quickly grinds valves to a seat. It produces an absolutely smooth seat and prevents the forming of ring grooves or cutting surfaces.

The oscillating motion of this grinder is obtained by gear *A* driving gear *B*, which has crank *D* pinned to it and carries roller *J*, placed one inch off center. This roller forms a crank pin and, being rotated by gear *B*, works in the elongated slot in *F*, giving an oscillating movement, which is necessary to grind valves accurately.



THE GRINDER READY FOR USE



DETAILS OF THE GRINDING DEVICE

The valve driver can be made like a screw driver, or to suit the valve to be ground. It should fit the valve tightly, so as to lift it up and down when grinding. Flat-head screw *G* and washer *H* bolt *F* to *A*, which is machined so as to be a running fit in the bronze casting *C*. Handle *K* is a piece of one-half inch cold-rolled steel pressed into the casting *C*, and can be held by hand or made long enough to stop against the drill-press column.

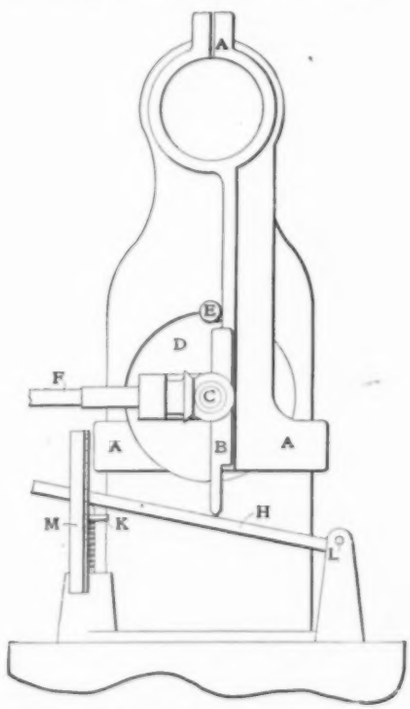
R. H. Mitchell.

The Cutting of Simple Edge Cams

In cutting edge cams, "Arteby," "Dynamic" and "Milling Hand" agree only on one point, which is the importance of accuracy.

Arteby lays out his former five times the size of the desired cam, then roughs it out by varous devices and files it up by hand, depending on the cam-cutting machine to correct the errors in its reduction of five to one. Dynamic cannot cut with accuracy without making gears for each lead on the cam, unless the cam is designed to fit the gears instead of the work to be done. Milling Hand cannot take an exact finishing cut unless the cam is first roughed out.

In cutting a cam of this kind it is necessary to have two directions of feed, one circular and the other toward the center. These must be accurate and easily adjusted to cut perfect cams, and all parts must be held firmly to get speed and therefore a low cost. On a milling machine these requirements can be met by so mounting a slide that it can be given a vertical motion in front of the cutter. On this slide mount a spindle to carry the cam blank to be cut and arrange to drive this spindle from the feed screw of the table and to control the vertical motion of the slide by an adjustable inclined plane fastened to the table. When such a fix-



CUTTING DEVICE FOR SIMPLE EDGE CAMS

ture is made and used correctly a cam of any throw can be cut with a variation of not over one thousandth of an inch for its full circumference. The same setting can be used for the roughing and finishing cuts.

The outline illustration shows the fixture which I have used. At *A* are the clamps which fasten the fixture to the milling-machine pillar. *B* is the slide, *C* the spindle and *D* the cam blank to be cut. The inclined plane is at *H*, with its fulcrum at *L* and controlled by the adjusting screw *K*. The scale *M* is used to set the inclined plane. The spindle *E* is geared to the flexible shaft *F* and this in turn connects with the feed screw.

and quick method of change from one throw to any other throw of cam desired.

J. BERTRAM.

How a Small Foundry Tackled a Large Job

It is easier to do a piece of work when you have everything at hand than it is when everything has to be planned and then the fixtures collected. In this article we will try to describe how a large job was done in a small foundry, a job that required good substantial rigging in order to be successful; it was the making

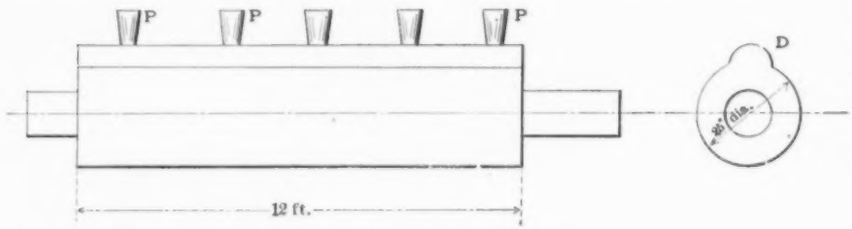


FIG. 1. THE ROLL TO BE CAST

FIG. 3. WOODEN LEVER FOR CONTROLLING LADLE

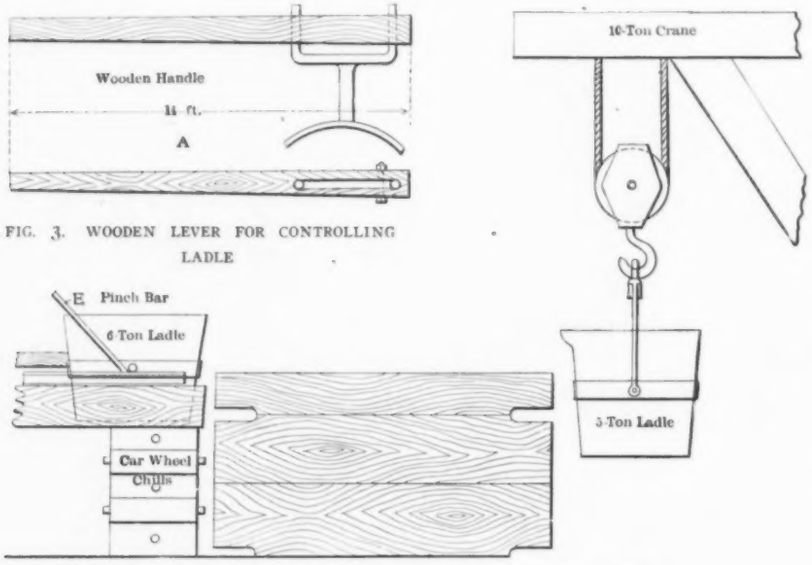


FIG. 2. POSITIONS OF LADLES FOR POURING THE MOLD

If this is mounted on a milling machine and the feed screw geared so that the cam blank will make one revoluton to 10 inches of travel to the table, and if the distance from the fulcrum *L* to the scale *M* is 10 inches, then the throw of the cam will equal the distance, measured at *M*, that the inclined plane *H* is raised above the level. If we wish to cut a cam with a rise of ⅛ inch in 300 degrees, we will have $\frac{360}{300} \times \frac{1}{8}$ inch $= 0.15$ inch, or the distance which the plane should be raised above the level, measured on the scale *M*. By graduating the scale in hundredths and using a vernier, the inclined plane can be set to a thousandth of an inch per revolution of the cam, giving an accurate

of a large roller as shown in Fig. 1. The dimensions shown will give the reader an idea of the size of the roll. In the end view is shown a rib at *D*, which is cast the entire length of the roll and has the risers *P* at intervals. We had no pit deep enough to cast the roll on end, so this top was cast on to catch any dirt that might rise to the top of the mold and this, of course, was planed off before the roll went to the lathe. Strange to say, we got a perfect casting this way, though almost any molder would want to make it standing on end.

Fig. 2 shows how we had to arrange to pour this mold. We had one crane and one good geared crane ladle, as shown, and we also had one large flat-bottomed ladle and one large shank ladle. You will note the pile of car-wheel chills upon the top of which are arranged some heavy timbers, and on this we have also some pieces of railroad iron as shown at *M*, which were used so that the ladle could be slipped while pouring. As before stated, the ladle was quite flat and we had to advance this as we poured our casting. In Fig. 3 you will see how we made a lever and safety handle for this large bowl of iron. As it was easy to trip, we used the strong wood lever fastened as shown in the cut.

We filled this ladle from the crane ladle, and then filled our crane ladle and were ready for business. We had some good men on the lever and also some men with pinch bars, as shown at *E*, to advance the ladle when we were pouring the mold; by using the long lever we had good control of the large ladle of iron. We had everything securely arranged, and as our men were well organized we got out the casting without a hitch.

C. R. MCGAHEY.

Drilling Knuckle Joints—A Boring-tool Holder for the Miller

I would like to point out that the design of a drill jig for knuckle joints, by "Rover," England, at page 286, is faulty in more respects than one. He says that "after eight months' use the jig gives satisfaction in accuracy and speed." From my experience, a threaded drill bushing rarely, if ever, gives satisfaction, and certainly not after a little usage. It is impossible to retain its accuracy after hardening, takes longer to make, and also necessitates extra work in boring and threading the jig to suit. The jig shown would have been better without being clamped at all in this direction, for instead of preventing springing, it is more likely to cause it. Loose pieces of any kind in a jig are objectionable. A jig should be designed so that as little expensive labor as possible need be expended upon it. In his design it is imperative that a great many parts must be very accurately machined. There are three separate grooves to slot, to which four pieces must be nicely fitted; the bushing must be located exactly central with V pieces, which is difficult for the toolmaker; the distance between the bottom of the steel block *C* and the surface *X* must be exact, and the hole for the clamping screw must also be nicely located if the end of the screw is to fit the hole in the knuckle joint.

I was much interested to note, a short while back, that Syd P. called attention to the fact that tool draftsmen were too fond of using cast iron for jig bodies,

when machine steel is sometimes better and can be utilized without so much labor. This is most obvious in the case to which I have called attention, and I submit a sketch following out this idea.

Fig. 1 needs little explanation. The body is a piece of cold-rolled, or if this is not to be had, ordinary bar machine steel, finished all over. The groove marked *x* is first milled out, and then the two grooves marked *y*, which leaves the locating block *z* to fit nicely the gap in the knuckle joint. This is locked to square

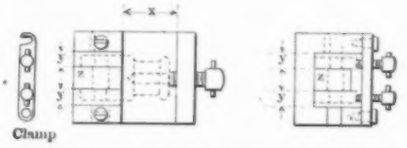


FIG 1. DRILL JIG FOR KNUCKLE JOINTS

end of *z* by the lock screw at the end of the jig, and fastened securely down on the base by two screws in the swinging clamp. An ordinary hardened and ground tool-steel bushing is used. Almost any boy in the shop could do all the rough milling on this jig, leaving 1/32 inch on the central block for the toolmaker to finish off accurately. The only other point which requires care is the location of the bushing hole. After the boy had done the rough work I would guarantee to finish this jig in 10 to 15 hours.

I know that many employers insist upon having *pretty* jigs and fixtures designed, but I think if draftsmen brought these cheaper tools more into notice, they would find favor in many instances.

Fig. 2 shows a boring-tool holder for the milling machine, which will appeal to many toolmakers on account of its simplicity and easy manufacture. The machine-steel body *A* is turned to fit the col-

FIG. 2. BORING-TOOL HOLDER FOR MILLING MACHINE

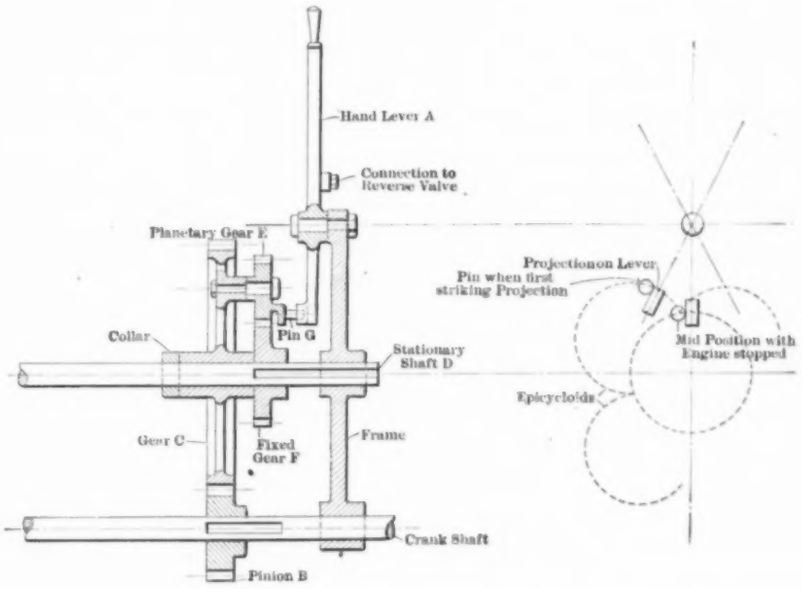
let of the milling machine or to suit any special chuck, whichever is more convenient. The hole in it is bored about 1/16 or 3/32-inch out of center, after which a section is cut away to give room for the set-screw shown. The body is then split, sufficient spring being obtained to hold the sleeve *B*. This is put into place, and both the body and sleeve put into the milling machine and the hole for the boring tool bored in *B*, this hole, of course, being eccentric with the outside. The tapered face of *B* is marked with suitable graduations, and zero marked on the front face of *A*. *B* is also split to hold the boring tool. It is quite evident that if the set-screw be loosened and *B* turned around a little, the boring tool inserted therein will be thrown a little more out of center, and by this means a hole may be bored to exact size with greater ease than by the usual uncertain method of bending the boring tool. This holder was made by one of our toolmakers and gives great satisfaction to those who occasionally borrow it. It is just the simplest and cheapest I have yet seen.

SHOLTO MCKIM.

A Stop Motion

The device shown in the sketch is in successful operation on a swinging engine put out by a well known concern building valve-reversing engines. The movement of the engine is at all times under the control of the operator, the function of the stop being to prevent overtravel.

The hand lever *A* controls the valve (called the reverse valve) by which the engine is started, stopped and reversed. A



A STOP MOTION

pinion *B*, on the crank-shaft drives a gear *C* revolving loosely on a stationary shaft *D*. This gear carries a planetary gear *E* that meshes with a fixed gear *F* on the stationary shaft. The planetary gear carries a pin *G* that will, in two positions, strike the projection on the hand lever, once on one side and once on the other. These two positions mark the ends of the travel, the engine being under perfect control between these two points; and it will not run by them.

The motion of the pin is in an epicycloid. The pointed part of the curve (vertex or cusp) is used at the time of striking, with the result that the lever is moved quickly but with a reducing speed, and so has no tendency to overtravel.

It was found that the speed at the flat part of the curve was sufficient to throw the lever from one side to the other, and keep the engine in continual motion.

E. D. MUND.

Proposed German Metric Standard Drill Shank Taper

According to the "*Zeitschrift fur Werkzeugmaschinen und Werkzeuge*," action has been taken in favor of discarding all American drill-shank tapers and adopting a standard German taper. The reason for this is that the American system is not consistent, and that there is in any case in machine building a certain lack of system in the conicity. The catalog of one of the largest German manufacturers of tools says that there are in the American taper the following things to complain of:

1. In the course of time there have been repeated changes therein, so that there is lack of interchangeability;

2. All the dimensions are irregular quantities which cannot be easily reproduced;

3. The tapers are not the same, that is, each number is of a different conicity from the others.

It also seems fitting to German manufacturers of machine tools that they should have a taper system of their own, corresponding to the metric system.

Now pressure has been brought to bear on the governmental authorities, and especially those of the Prussian railways and the imperial shipyards; and while the railway officials have not as yet expressed any opinion as to the introduction of a metric taper, those of the imperial shipyards have already expressed themselves as willing to adopt drill presses and drills with a metric taper.

Almost all the German manufacturers, except the Remscheid firms, have announced themselves as willing to deliver twist drills and drill chucks with a metric taper, without any extra charge; and if there is any great demand for them, to

stock them. In this direction the following firms have expressed themselves: J. E. Reinecker, Chemnitz-Gablenz; R. Stock & Co., Berlin; Vogel & Schemmann, Kobel i/W; Rohde & Schmachtenberg, Düsseldorf. The firm of Edward Wille, in Cronenberg, will make an extra charge for metric taper only so long as separate parts must be made to order; but will make no extra charge as soon as the demand for the old taper falls off.

The reason announced by the Remscheid firms for their position is that formerly when it was attempted to introduce drills with a German taper the attempt was a failure; but this position is not considered by the committee of the union of German tool builders as well taken.

ROBERT GRIMSHAW.

THE OTHER SIDE HEARD FROM

With reference to the other side of the recent decision of the union of German machine tool builders that it considered the adoption of a metric taper for drill shanks, etc., highly desirable—a decision agreed to by the imperial shipyards, held under advisement by the Prussian state railway authorities, and dissented from by the Remscheid manufacturers of twist drills and kindred products affected by any change in the standard—the German manufacturers of twist drills, recently meeting in Hannover, resolved as follows:

"The German manufacturers of twist drills, here assembled today in Hannover, declare unanimously that the proposed introduction in Germany of a metric standard instead of the Morse taper, which is without any exception introduced in all civilized countries, for twist drills, would not only bring therewith no advantage, but would be, from an economical point of view, of incalculable injury not only to the consumer, but also to the entire highly developed German twist-drill industry.

"The manufacturers of twist drills therefore address to the higher state authorities, and to consumers, the respectful request, to abstain from the introduction of a new German or metric taper, until by international agreement the general introduction thereof is assured."

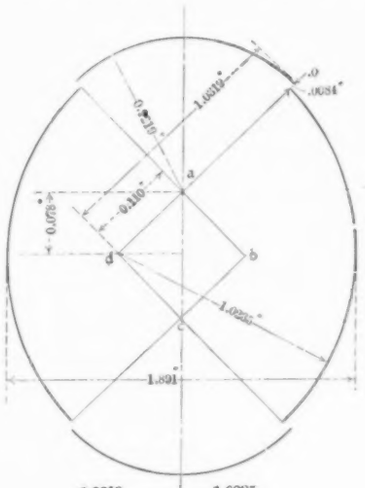
The reasons for this decision will be made public later.

ROBERT GRIMSHAW.

[Oho! the shoe pinches. In such a comparative trifle as drill-shank tapers the introduction of the metric system "would bring no advantage," and "be of incalculable injury." Why don't they measure the existing tapers in millimeters and call them metric? That is the easy-going solution to all these difficulties by our amateur American metricites. By the way, who says the metric system is not universal in Germany? Perish the thought!—ED.]

Laying Out and Machining Elliptical Gears

Referring to the article on elliptical gears, by M. B. F., in the AMERICAN MACHINIST at page 479, it seems to me that there was a small error in figures. The radii of arcs from *a* and *c* as centers are 0.1016 inch less than from *b* and *d* as centers, while the distance from *a* or *c*



0.9219	1.0235
0.110	0.9219
1.0319 = Sum	0.1016
1.0235	
0.0084 = Diff.	

FIG. 1 According to M.B.F

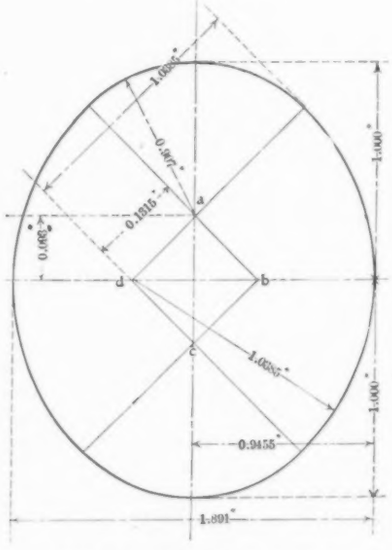


FIG 2 According to J. D. W.

LAYING OUT AND MACHINING ELLIPTICAL GEARS

to *d* or *b* is 0.110 inch (distance which should be added to lesser radius to form greater), leaving a space of 0.008 inch where arcs are supposed to join. My method, which as far as I can see comes correct, is as follows: Represent the distance from the geometrical center to the centers of the arcs by x. Then 1 [which is ½ (major axis + 0.0625)] $- x + 1.414\,x$ (distance *a* to *d*) $= 0.9455 + x$. Solving, we find x equals 0.093 and distance *a* to *d* equals 0.1315. Fig. 2 shows that these figures are correct.

$$1 - x + 1.414\,x = 0.9455 + x;\ x = 0.093.$$
$$0.093 \times 1.414 = 0.1315$$

J. D. W.

The author of the article referred to has supplied the following remarks with reference to the above criticism:

The correctness of J. D. W.'s figures as regards centers from which may be struck arcs that will join on the 45-degree line is conceded. However, his figures will come no nearer making a perfect ellipse, and the error will be in a direction that will enlarge some parts of the smaller arcs so that the gears might not run freely. In either case the smaller arcs are inclined to be too large and the larger arcs too small to follow the theoretically correct curve. To balance this, in the actual working drawings, the radii of the smaller arcs are shown shortened and the radii of the larger arcs slightly lengthened, making the arcs join at space 7, Fig. 2, page 479.

My aim is to select arcs that will follow the correct curve as nearly as possible, but will in no case go outside of it enough to interfere with the free running of the gears. M. B. F.

The Helping Hand to All Who Deserve It

The editorial which appears at page 436, concerning the "Young Technical Graduate," was interesting, but I cannot altogether agree with the main idea, which, as I take it, is that the young men spoken off need more of "a helping hand." I am at present watching several young fellows all working in the mechanical line and all after the same thing; first, plenty of money, and second, to know the why and wherefore of every piece of machinery which comes above their particular horizon. In the editorial referred to we have pictured a young man 22 or 23 years of age, who has spent practically all of his time at school and college, and suddenly finds himself cast upon the cold and unsympathetic world.

To me this case is about as unlikely as that said young man's father or guardian should die on commencement day and leave him friendless. Where will we find anyone who has gone steadily to school without either having the "necessary" coming from a source which will not shut off so suddenly, or else having made it himself? If the latter, we need have no fear as to his future or to whether anyone gives him a helping hand or not. I do not wish to discourage the idea of helping our fellow beings, but the great need is of fellows who help themselves. The boys who go to school all their young days and have their careers laid out ahead by loving and moneyed parents are not generally the ones we

wish to have for superintendents, as they are often better fitted for the parlor and such places as Newport, with games of polo, golf, etc., as their chief interest in life.

THREE-QUARTERS FAILED

A doctor who graduated some twenty-five years ago and is today well off, with a large practice, told me that, as far as he was able to ascertain, 75 per cent. of the fellows who graduated with him were either dead, working at low wages at such positions as hack-drivers or waiters, or simply living off money left by others. The other 25 per cent. included those who had died while practising their profession and those now practising, as he is.

The college was a high-priced one, and practically without exception the boys of that class were being supported by relatives or friends.

Now let us look at the other side, or rather the boys who "get there" themselves. What change of enviroment causes *this* fellow to stagger? Could harder things come to him than he has already experienced? It is a well known fact that those who have the wolf very close do not dread him as those who only hear very faint murmurs of his howling. I do not write this in the free and easy manner which goes hand in hand with hearsay, but because I have been there, and in fact have patted the old dog (he is only a tame dog when you know him) on the head and bidden him a good long farewell. I will not say a last farewell, as we have only to look at the daily papers to read of men who had a million between wolfie and themselves, but who today are quite chummy with him, though many of them prefer to get chummy with a loaded gun, never having been on speaking terms with the hypothetical animal thousands live with.

MEN WHO WON'T GO TO COLLEGE

There are some young men who do not recognize the value of a college education, and yet are in practically the same boat, as far as success goes, as their brothers who work their way through. Take for example a young chap I have at present under observation. He used to run home from school as a boy and stay in the woodshed with his little lathe (made out of an old sewing machine) and other contrivances, until his mother called him for supper; after that was over, back to the shed with a lantern until he would be either driven in to study his lessons or to bed. At 16 he quit school and devoted his time to making toy engines and such things, gradually changing from toys to practical things.

At the age of 21 this young man went to New York and got a job with a large firm as a machinist, and a little later I got a letter from the young chap saying that he was at present receiving $5 per day of eight hours, looking after some automatic machines. His father always wanted him to go to college and does yet, as the happenings of which I write are not a year old; but the boy persists in working away day and night at practical iron and steel lessons instead of algebra, etc.

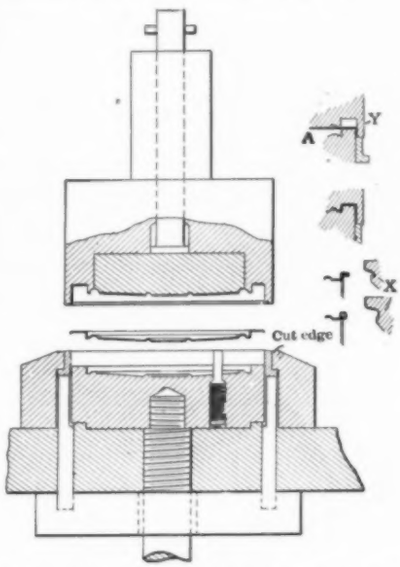
Whether he will ever reach the hights he might by taking a college course is a question we shall probably never be able to answer, but that he will probably reach higher than 75 per cent. of the usual college men is almost certain.

My idea would be to give a hand to the deserving, regardless of their education.

NERALCM.

Inverted Redrawing of Can Tops, etc.

Inverted redrawing or inside-out reducing of cups and other drawn shapes is known and practised in many press rooms, the usual object being a reduction



THE DRAWING DIES AND SEAMING ROLLS

of diameter and sometimes for the purpose of securing a certain ornamental shape, though this is usually considered embossing, there being no actual flow of metal, strictly speaking. The object in this case was a "burred edge," as it is known, and this edge was required for the operation following, that of roller seaming.

The tools will readily be understood from the sketch, and the operation easily followed by the side-show studies. The punch cuts its own blank and draws up a shallow cup, as shown at *A*. Further descent turns this cup inside out at a smaller diameter, and all, but obliterates the larger diameter, leaving the edge of the flange nicely turned over and embossing any desired design or trade mark on the body, the shape shown being known as the double-panel "snapper" fruit-can top, the bulge being intended to remain as it is shown unless for some reason the contents of the can spoil and by fermentation cause a pressure which "snaps" or bulges the heads outward, thus indicating that the contents are unfit for food. The smaller panel in the die and knock-out is usually made removable, so as to present different designs, advertising matter or a special factory mark.

Noticing a few features about the die, it will be seen that the bevel edge permits two or three upsettings of the punch before it is necessary to refit it to the ring, and that it can be refitted a few times before the whole punch must be sunk back. This bevel is only permissible in round work; oval and other shapes had best be flat, as it is not convenient to lap such shapes to the ring. Two more points in the making should be watched to insure a good job: The corners of the drawing block should be rounded in such a proportion that the larger diameter of the cup delivers to the flange only as much metal as the smaller diameter extracts from the flange. If the outer corner delivers too much stock, wrinkles will inevitably creep in. Once they start, no amount of hammering will chase them back, and they can go nowhere else. The other point to watch is the corner *Y*. If this corner is drawn too far it will flare outward and hug the walls of the drawing punch so tightly that the work cannot be extracted, as the plunger aggravates the trouble. This fault is avoided by making the corner *Y* a close fit, so as to iron out the metal at that point, confining the metal to a slightly smaller diameter than that of the punch. When this is done, little attention need be paid to the actual diameter of the punch, as the wear permits easier extraction and the diameter is kept within limits by watching the corner when resinking.

The spring pins shown keep the work, and thereby also the press hand's fingers, from under the punch. I also show at *X* the seaming rolls, which will make a neat seam on decorated metal or a perfect seam on plain tin without solder. I have seen these joints stand up under a pressure that distorted can heads into hemispheres.

SIRIUS.

Calcium carbide in the form of sticks or blocks is now being made in the electric furnace at Niagara Falls, New York. In this form the calcium carbide can be exposed to moist air and handled without suffering appreciable decomposition; it can be caused to give off gas with great regularity when used in a suitable generator, and when the generation of gas is to be stopped this can be done practically instantaneously.—*Mechanical World.*

In a recent report of a test of automobiles the reporter calmly announced that "five of the cars were air cooled, the remainder being gasolene." Truly a little learning is a dangerous thing.

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An Important Industrial Treaty

We publish in another section of this issue an article appearing in the Financial and Commercial Supplement of the London *Times*, which should be of interest to every reader who wishes to keep posted on what may be done by organizations of engineering employers and workmen in the way of establishing businesslike and workable industrial agreements.

As will be noticed, this agreement has been drawn up, and provisionally signed by the respective executive bodies just a decade after the opening of the most serious labor struggle in the history of British industries; a struggle which, commencing in the summer of 1897, was continued for well over six months, or until the beginning of the year 1898. At this period the engineering employers drew their numerous local associations together into a strongly organized federation, and a general federation of the various engineering and shipbuilding trade unions also took place. The disturbances which have occurred since the settlement of the trouble at that time have been largely local, and have been adjusted with little difficulty by the organizations concerned. The present agreement has been drawn up after frequent discussions and proposals for revision of the one formerly made. Its most important provisions are given in the *Times'* article, which we reprint, and as will be seen from the discussion therein of these various points, it is expected that this industrial treaty will work fairly toward all parties concerned, and that it is likely, in fact, to serve as a model in such matters for manufacturing countries in general.

Suppression of Tuberculosis among Factory Operatives

A movement that should affect beneficially employees of shops and factories was recently set on foot in Providence, R. I., when a number of physicians and manufacturers held a meeting for the purpose of discussing means of checking the spread of tuberculosis among factory operatives in the State. Various suggestions as to methods tending to lead to the eradication of the disease were proposed by representatives of prominent manufacturing concerns and by tuberculosis authorities. A committee was appointed to investigate the subject and confer with different factory proprietors as to feasible methods of attaining a higher degree of sanitation in Rhode Island establishments. This committee is headed by Joseph E. Fletcher, president of the Coronet Worsted Company, and Dr. Gardner T. Swarts, secretary of the State board of health, is also a member. According to the Providence *Board of Trade Journal* the committee has already conferred with representatives of the local board of trade and a campaign of action has been mapped out which it is believed will produce definite and important results.

Naturally much of the work of improving conditions affecting the health of working men and women in factories must be along educational lines; undoubtedly in every important manufacturing community there is a field of opportunity for aggressive and practical organizations interested in the welfare of mill and factory employees. Discussion with employers regarding methods of improving sanitation and dissemination among operatives of information emphasizing the danger of spreading tuberculosis through carelessness should go far toward bringing about a condition of affairs beneficial to present and future generations.

People who have lived in what are commonly called factory villages realize something of the extent to which operatives fall victims to tuberculosis and other diseases only too frequently transmitted through carelessness or indifference upon the part of themselves and fellow operatives. By keeping their factories clean, well lighted and well ventilated, employers can do much toward keeping their various classes of workmen in sound physical condition. Yet individual or concerted action by manufacturers can accomplish the best results only when such action is accompanied by a willingness upon the part of the operatives to follow hygienic rules during working hours and in their own homes as well.

As regards sanitary matters in machine plants, machinists, draftsmen and others who have traveled extensively and worked in numerous establishments know how little attention is paid in certain quarters to the most ordinary rules of sanitation, while in others every effort is made to maintain healthful conditions in shop and office. In addition to the features of adequate ventilation, sunlight and proper toilet facilities, there are a few things which might well receive more attention than they do in a good many places. One of these is the item of cuspidors, which, while plentiful enough in some shops, are enirely absent in others, with the result that the floors are in a more or less filthy condition—a condition, in fact, often forming a positive menace to the health and lives of the workmen. Cuspidors of a type that can be readily cleansed should be available for all employees, and promiscuous expectoration should be strictly forbidden. Disinfecting solutions and daily cleansings should prevent these receptacles from becoming sources of danger. The old-fashioned wooden sawdust boxes which workmen so frequently provide for their own use, and which are usually in a foul condition, ought to be discarded entirely and replaced by metal cuspidors which admit of being kept clean.

New Tools and Machine Shop Appliances

Showing the Progressive Development of Modern Shop Equipment and the Progress of Design in This Department of Work

THE LATEST INFORMATION

Motor-driven Knife Grinder

The accompanying illustrations show a 144-inch knife grinder with cabinet bed, and with motor drive for wheel spindle and table mechanism. The cup emery wheel used on this machine is 24 inches diameter, 8 inches deep with 2-inch rim and is driven by a 7½-horse-power motor which is mounted over the wheel spindle on a substantial base and geared to the spindle, giving the wheel a speed of about 450 revolutions per minute. The emery wheel when set square grinds a flat surface and should it be desired to grind a slight concave the wheel and its motor can be swiveled, the base carrying the wheel, stand and motor support being adjustably mounted on the slide as indicated in the rear view. The hollow knife bar is of square section and long knives can be drawn down to it firmly to take out wind caused by tempering. In addition to the end supports for the bar, there is a center support which adds to its rigidity. On the end of the bar is a graduated dial so that the knife can be quickly set and ground to the same degree or bevel as previously ground. The bar is turned by means of worm, worm gear and hand wheel. The carriage is back geared and driven from a 5-horse-power motor by a pinion meshing with a double friction gear which slides back and forth on its shaft engaging first one and then the other clutch member for transmitting the power through the bevel reversing gears to the train of back gears. The dogs on the carriage may be set to accommodate any length of knife within the capacity of the machine.

The knife bar is fed forward to the wheel automatically by bevel gears and cross-feed screws operated in unison by the long shaft shown in Fig. 1 so that both ends of the knife are fed forward equally. The cross feed is regulated by a thumb screw and can be adjusted to remove 0.001 inch or as much more as may be desired. It will stop feeding and grinding at any

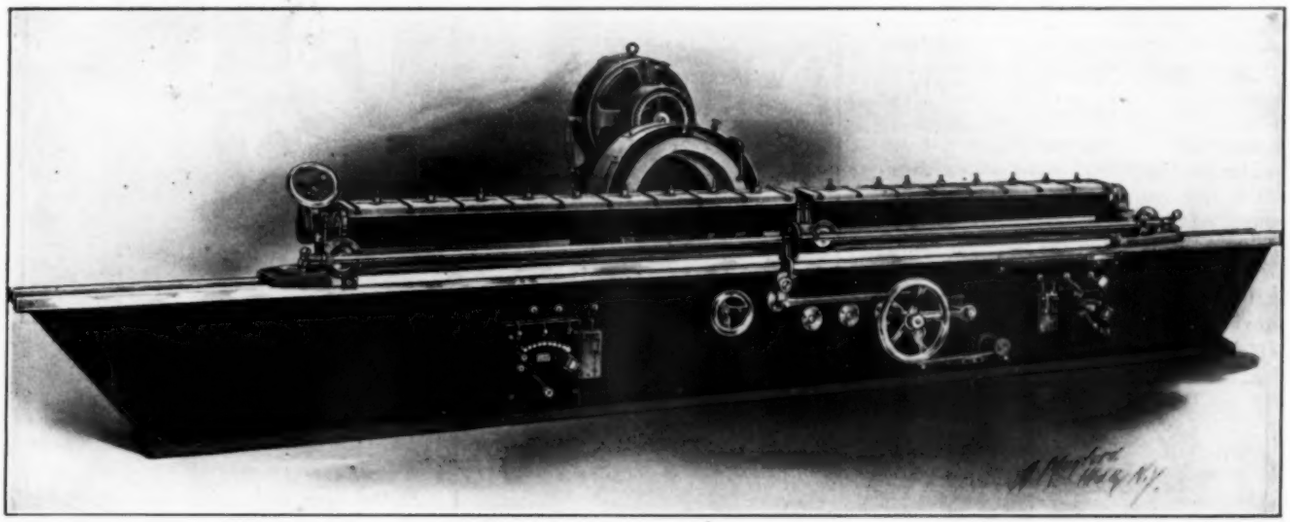


FIG. 1. MOTOR-DRIVEN KNIFE GRINDER

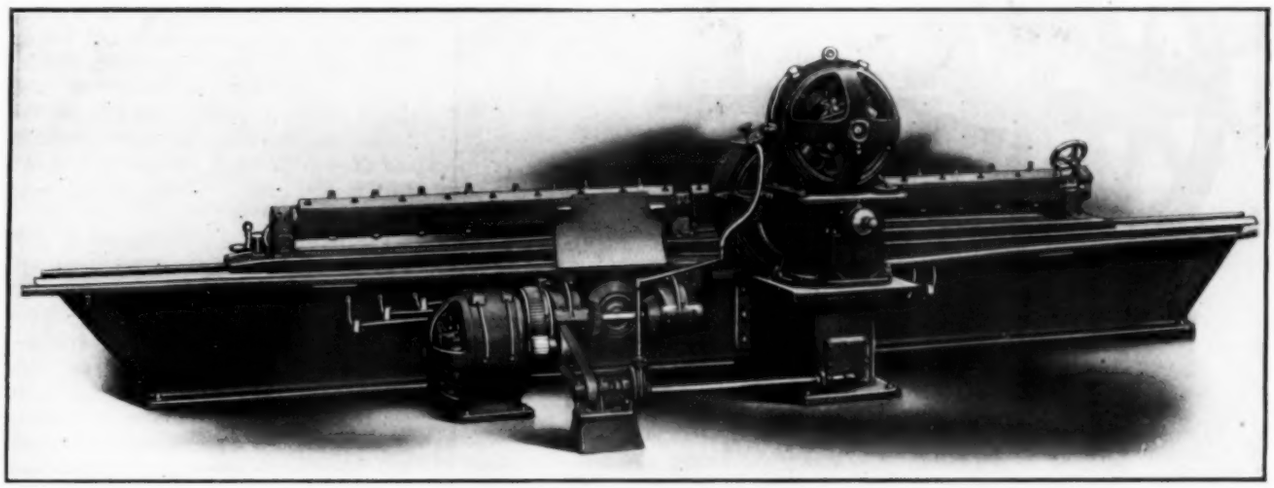


FIG. 2. REAR VIEW OF MOTOR-DRIVEN KNIFE GRINDER

point, hence, when properly adjusted and set in motion it requires no attention.

The knife bar can be readily run forward to the wheel by means of the feed rod handles and the wheel may be moved forward on the dovetailed, gibbed ways on the extension at the rear of the bed by means of the small hand wheel located at the middle of the bed. In the center of the large hand wheel shown at the front of the bed there is a knob which controls the friction gear. Loosening this nut will immediately stop the carriage motion without the motors being stopped and the carriage can then be moved back and forth by means of the hand wheel.

This grinding machine weighs 9000 lb.; it is built by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn.

Automatic Spur-gear Cutting Machine

The two half-tones show a new automatic spur-gear cutting machine, with a capacity for cutting spur wheels up to 60 inches diameter, 16 inches face, 2½ diametral pitch in steel, and 2 diametral pitch in cast iron. The unusual length of face is provided for by the long cutter-slide construction and the arrangement of the

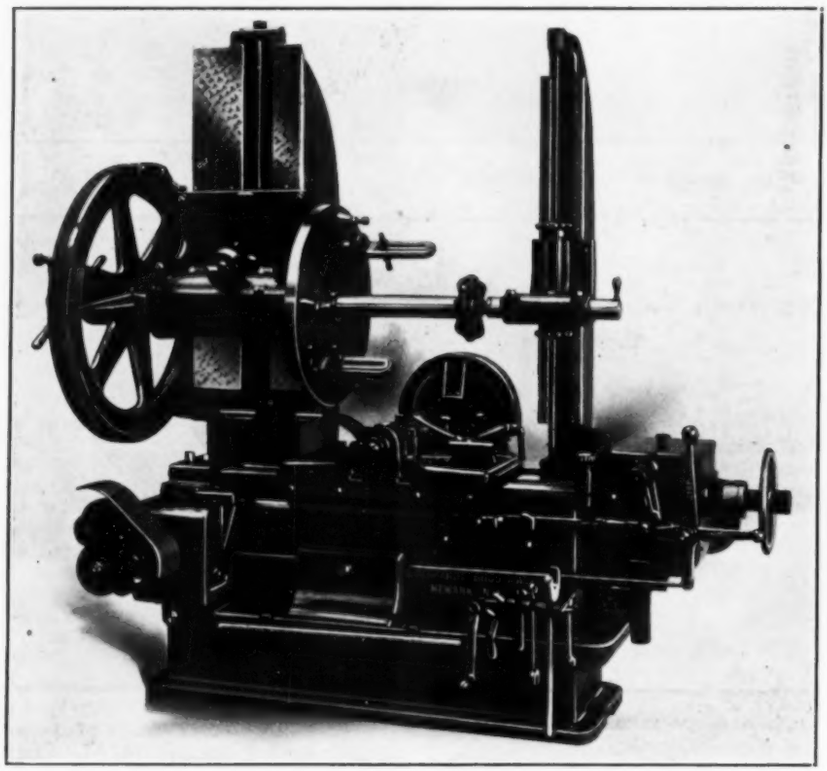


FIG. 1. AUTOMATIC SPUR-GEAR CUTTING MACHINE

frame, which allows the cutter to cut up close to the column. The spindle bearing is in the center of the slide, and the "draw-cut" principle is used, whereby the feed screw is under tension when feeding or returning the slide. The slide is thus drawn, and not pushed. This long slide construction eliminates the danger of the cutter slide lifting or the parts chattering while the cutter is entering the work.

The spur-gear drive is advantageous for the high spindle speeds used with the high-speed steel cutters. A good test of the drive and feed mechanism was shown in the cutting of 3 diametral pitch in 30-point carbon steel, 5 inches face, from the solid, using a roughing and a finishing cutter side by side, at a feed of 4½ inches per minute. These cutters were, of course, regular carbon-steel cutters, and the feed and speed could have been increased if they had been of high-speed steel.

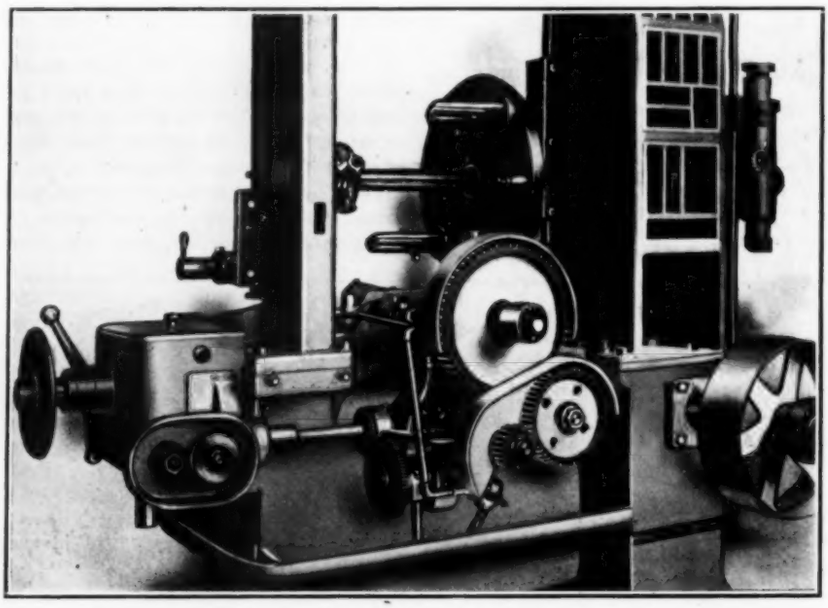


FIG. 2. DRIVING MECHANISM OF GEAR CUTTER

The Feed Mechanism

A new feature which is being embodied in these machines is a double train of feed gears, whereby double the range of feed usually provided for is obtained without extra change gears. This is operated by means of a sliding double gear, moved by a handle, so that with any pair of feed-change gears in place, two feeds can be obtained. These are so arranged that one feed is suitable for the first cut when using a finishing cutter and one or more roughing cutters in a gang, and, by sliding in the "back gear," the "fast" feed rate is obtained, which is suitable for the successive cuts. When the gear is finished and the next blank is in place, the "slow" feed is obtained by merely sliding over the "back gear."

The feed changes are arranged in geometrical progression, ranging from ¼ inch to 15 inches per minute. As the cutter speeds range from 20 to 128 revolutions per minute, the new feed arrangement allows the use of high-speed cutters to advantage, inasmuch as fast feeds can be used, which would be difficult to obtain in the usual range of feed changes. The feeds and cutter speeds are independent, one being changed without affecting the other.

The Indexing Mechanism

The index wheel is of large diameter, and is made in two sections. It is hobbed in place; the indexing mechanism is positive, employing a locking disk, operated by a positive clutch. The disk makes one or more full turns, and is locked in position at the end of each indexing, without depending upon momentum. Change gears

are provided to cut all numbers from 10 to 100; and all from 100 to 400, including multiples of the prime-number change gears but excepting the prime numbers over 100. A large number of divisions above 400 can be made, of course.

The indexing mechanism, when indexing, automatically locks the feed, so that the cutter slide cannot feed until the division is completed. The feed also is interlocked with the indexing mechanism, so that it cannot index while the slide is feeding.

The levers for engaging and disengaging the feed, and for indexing by hand, are placed on the operating side of the machine, to facilitate the setting. After the machine is set, it goes through the feeding, returning at a constant fast rate, and the indexing, all entirely automatically, without any attention on the part of the operator.

This machine is No. 5 of Eberhardt Brothers, Newark, N. J.

A New Quick-acting Wrench

One of the things which nearly every mechanic tries to improve is the screw wrench, more commonly known as the monkey wrench. But in spite of all the thought and money that have been expended, as well as the acknowledged weak points of the screw wrench, it is still in use in every shop.

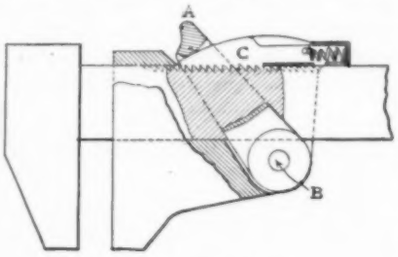
THE "INVINCIBLE" QUICK-ACTING WRENCH

One great trouble with most quick-acting wrenches having teeth or notches to hold the jaw has been the inability for close adjustment. They are also very apt to wear and cause trouble from that source.

The wrench shown, called the "Invincible" by its inventor and patentee, Noah W. Rasnick, of Dante, Va., seems to have several advantages. The ratchet teeth are rather fine, but the main feature is the lock or dog which fits the ratchet and the strap which forces it into place.

Placing the wrench on a nut, the sliding jaw is moved up against it by the thumb, which continues pressing against the strap *A*, hinged at *B*, forcing it forward over the curved back of the lock *C*. If the nut happens to be of a size that corresponds with the notches, the strap will go to the extreme forward end of the lock. In other cases it will stop at various points, but always brings the lock tight to the bar and then forces the jaw against the work.

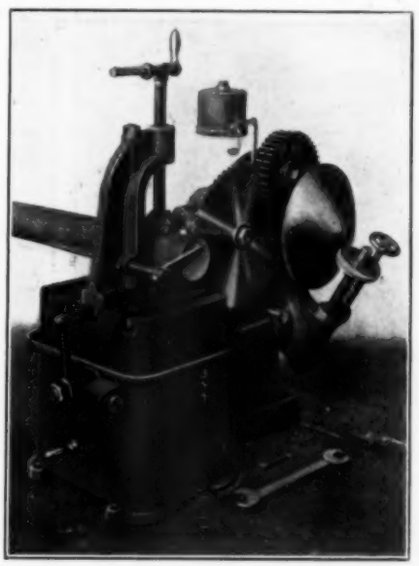
While an actual shop test of months or years, showing the effect of wear or clogging with dirt and chips, is what really decides the merits of any device of this kind, this seems to meet the requirements of a practical wrench fully as well as any special wrench we have seen, and unless hard usage should develop weak points which are not apparent, it should find favor with those who do not find the regular wrench entirely satisfactory.



DETAILS OF THE ACTION

Cold-saw Cutting-off Machine

The illustration herewith shows a cold-saw cutting-off machine which has a novel method of driving the saw, this being rotated from the periphery by means of steel rollers which are hardened and ground, and journaled in removable steel bushings held securely in the double driving gear. By this method of driving, a large portion of the blade is available for cutting, as little space is occupied by arbor collars.



COLD SAW CUTTING-OFF MACHINE

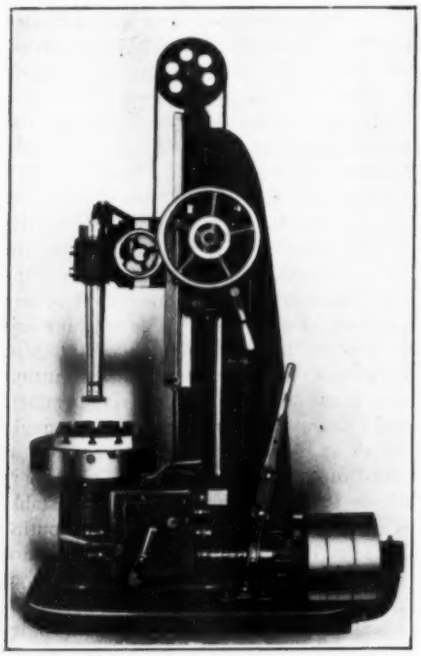
A radial T-slot is formed in the side of the carriage and the double gear containing the saw-driving rollers is journaled on a stud held in this slot. All that is necessary to take up the wear of the saw blade is to loosen the stud and lower the double gear until the rollers properly mesh in the saw blade. The shears and carriage are constructed with the gib on top of the ways, the latter taking the strain. The table is of sufficient size to enable beams and channels to be supported properly when being cut off at any angle up to 45 degrees. The machine has a saw 18 inches in diameter and 3/16 inch thick. It has a capacity for cutting round stock up to 6 inches in diameter, and I-beams up to 10 inches, at any angle up to 45 degrees. The saw runs at a speed of 35 feet per minute. The feed is of the variable-friction type, adjustable with the machine in motion, and continuous in its action throughout its entire range, the feed obtainable ranging from 3/16 to 1 inch per minute. The friction-wheel shaft is provided with roller bearings and has a hardened feed worm meshing in a bronze worm gear that is threaded to receive the feed screw. The latter is held stationary by a latch pin and the worm gear revolves around it, advancing the carriage while cutting. To return the carriage the latch pin is raised and the carriage returned by hand. The saw arbor is made from tool steel, hardened and ground. The bearings are all bronze bushed or babbitted. When so desired the machine is arranged for direct-connected motor drive. The maker is the Quincy, Manchester, Sargent Company, 90 West street, New York City.

Vertical Cylinder Grinder

The vertical grinding machine of which an illustration is here presented is designed particularly for grinding cylinders for internal-combustion engines and air compressors, and may be used for other holes and also for external grinding on pins, bushings, pistons, etc. The main frame, which is a single casting, consists of a base and column, the former supporting a rotating face plate, and the latter the cross-rail. The face plate, 20 inches in diameter, is made either with sets of T-slots at right angles, or with the sliding table, 16x12 inches, shown, the latter being used for such work as grinding duplex cylinders, making re-setting between the operations unnecessary. The table may be locked in any position by a clamp.

The grinding head is traversed on the cross-rail by a screw with a dial graduated to thousandths of an inch, this being accomplished by hand by the use of the

large hand-wheel, or it may be traversed automatically at any of six different feed ratios. The reversing can be by hand or automatically by means of adjustable dogs. The spindle is driven from the vertical



VERTICAL CYLINDER GRINDER

shaft. All operations are controlled from one side. When ordered specially, an attachment for the use of water, and an exhaust fan for the removal of dust, may be had, also a direct-current motor directly connected to the machine. The capacity of the machine for internal work is 13 inches diameter by 18 inches deep, for external work 6 inches diameter by 18 inches long; it is made by the Saxon Machine Company, Holyoke, Mass., and is designated by them as their No. 50 vertical cylinder grinder. The greatest hight is 88 inches, length 60 inches, and width 40 inches; net weight about 3250 pounds.

Improvements in the Bath Grinder

Among the improvements on the new grinders made by the Bath Grinder Company, Fitchburg, Mass., is the new spindle head with taper, phosphor-bronze boxes, split and adjustable. The spindle is hardened, ground and lapped, and the end play taken up by the back box. The adjusting collars have square threads. A guard covers the driving pulley in front, keeping dust from the bearings.

The wheel hood is clamped to the spindle head, top and bottom, in line with the center of the wheel, and affords maximum protection without affecting adjustment of bearing in any way.

The slot above the bearing in Fig. 1 is to support the arm shown in Fig. 2, which is used when surface grinding is to be done. This arm carries an adjustable bearing for the spindle and places it close to the wheel, to insure rigidity. The same water spout is used in both cases, but the surface grinding wheel has a special hood.

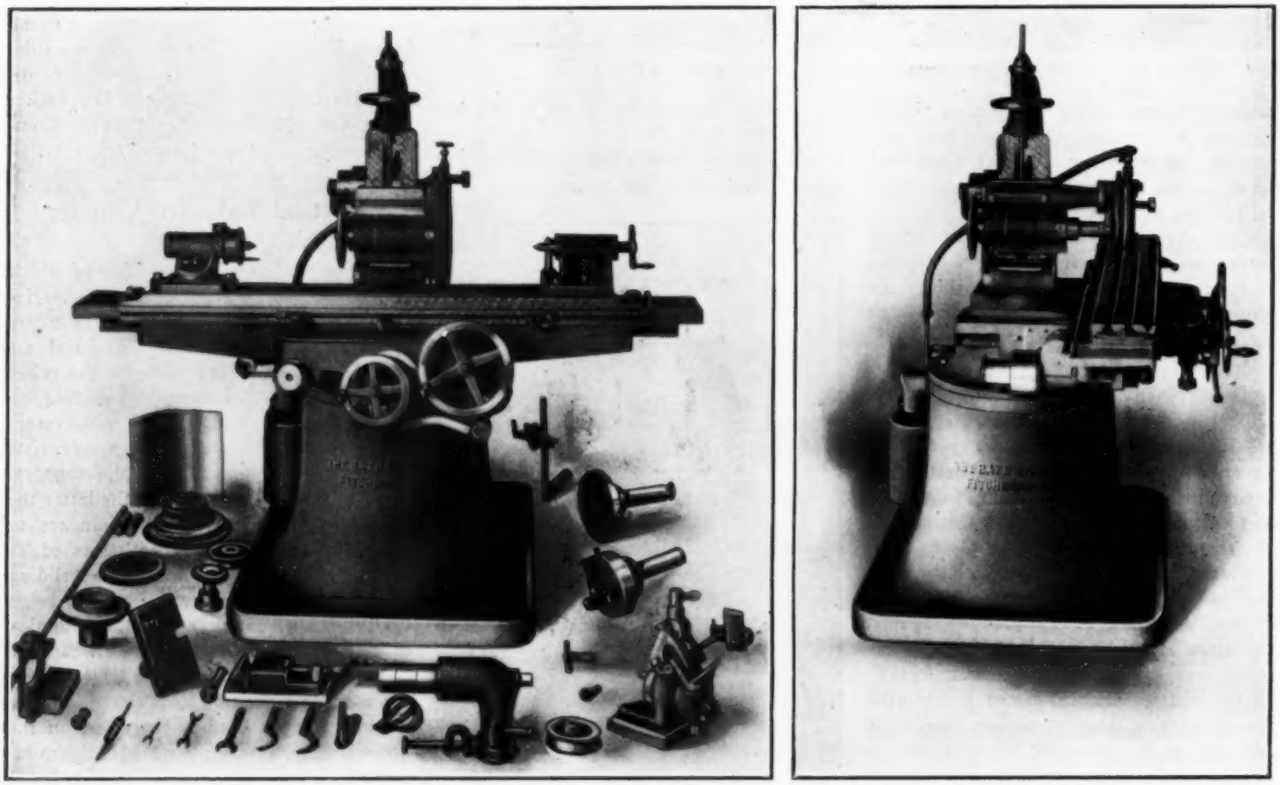
The extension spindle for the surface wheel is screwed on to the taper end of the spindle and has square slots on each end, so that spanners can be used for holding and removing. These features allow the change from cylindrical to surface grinding to be easily made. The elevating screw is graduated in inches and the revolving dial in thousandths, so that the head can be easily located and the amount of stock removed can be measured.

The driving of the wheel in this machine is accomplished without idlers, the variations in center distance being only 3/16 of an inch for extreme adjustment of head. This is taken up by moving the driving pulley by means of hand lock nuts on a threaded rod. This also allows a take-up of 4 inches of belt before cutting becomes necessary.

Another new feature is the handle at the left, which controls feed of table in either direction or locks carriage in any desired position. This places the control of the table in one hand of the operator and leaves the other free to adjust the work, as in cutter grinding.

Bearings under the table have been lengthened; water pans have been widened to afford all the protection possible; the cross-screw bearing is now on the floating or self-centering plan and can be removed by taking out three screws; hand wheels are enlarged and the positive stops now control the movement of the table within a limit of from one to two one-thousandths.

As a surface grinder it feeds 9 inches crosswise and 36 inches longitudinally, while for cylindrical grinding it swings



IMPROVED BATH GRINDER AND ATTACHMENTS USED FOR SURFACE WORK

9½ inches with regular heads or 14 inches with special head and foot stocks, and will grind to its full capacity.

Adjustable Shell Reamer

The engravings Figs. 1 and 2 illustrate a new adjustable reamer fitted with interchangeable blades cut off from stock which is drawn to half-round or D section and to exact size, so that it is only necessary to mill the tops of the blades before putting them into their seats in the reamer body. The grooves in the body are first milled with a half-round cutter as indicated by dotted line at *A*, Fig. 2, after which the metal is pressed over as shown at *B*. This is done when the diameter of the body is about 1/16 inch over size, so that it can be afterward turned down to a smooth surface. The collar which is shown at *C* in the sectional view

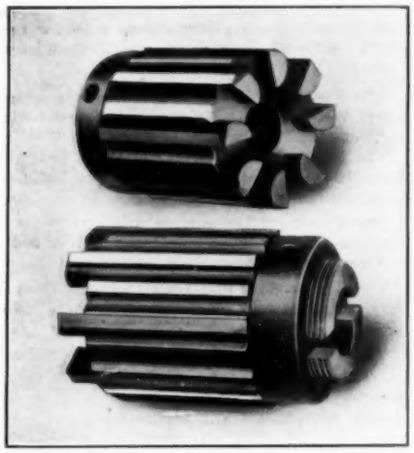


FIG. 1. ADJUSTABLE SHELL REAMER

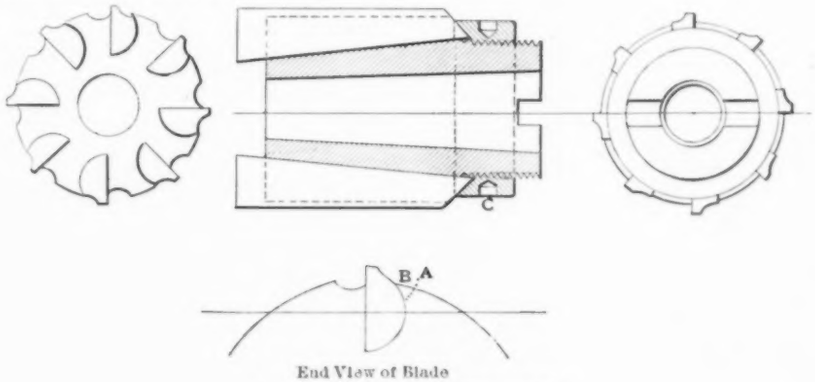


FIG. 2. ADJUSTABLE SHELL REAMER

is undercut so as to fit over the ends of the blades which are turned on a bevel. This helps to retain the blades in the bottoms of the grooves. This construction gives the blades a rigid support and also keeps them properly seated. The grooves are milled on an incline as shown, leaving more stock at the threaded part of the body and also permitting a larger taper hole to be used. As the blades are the same size and the metal about the grooves in the bodies is closed up on a master blade, making all the grooves of uniform size, the blades can be easily replaced when worn out, without refitting. The reamer is made by the Lapointe Machine Tool Company, Hudson, Mass.

Cross Multiplication as a Time Saver

By Harvey E. Brown

Referring to "Arithmetical Short-cuts," by Francis W. Shaw, at page 539, would it not be better to come at once to cross multiplication? To use one system for multiplying figures when they happen to be equal and to have to use another when they are not so, adds a difficulty without any compensating advantage that I can discover.

Cross multiplication involves fewer figures, it lends itself to the multiplication of numbers whether they are of equal amount or not, and it also enables almost any number of figures to be handled. One rule only (that of cross multiplication) is used whether a number is to be squared or whether two unequal numbers are to be multiplied. Whether there are the same number of figures in each number or not makes no difference in its application; neither does the fact of the numbers, or either of them, containing a fraction, assuming that the work is being done by engineers, most of whom instantly read fractions into decimals, mentally.

Cross multiplication is no doubt known to most people; but I do not find among my acquaintances that it is used to any thing like the extent it might be, and it may not be out of place to give an example or two here.

Taking Mr. Shaw's second example, 709×709, and for our explanation calling the multiplicand *A* and the multiplier *B*, thus:

$$\begin{array}{r} 709\ A \\ 709\ B \\ \hline 502681 \end{array}$$

we proceed as follows: multiply the units in *B* by the units in *A*, $9 \times 9 = 81$. Put down the 1 and carry forward the 8; then multiply the units in *B* by the tens in *A* and the tens in *B* by the units in *A*, and add together, $9 \times 0 + 0 \times 9 + 8 = 8$, the second figure of the product. Next multiply the units in *B* by the hundreds in *A* and the hundreds in *B* by the units in *A* and the tens in *B* by the tens in *A*, $9 \times 7 + 7 \times 9 + 0 \times 0 = 126$. Put down the 6 and carry forward the 12; next multiply the tens in *B* by the hundreds in *A* and the hundreds in *B* by the tens in *A*, $0 \times 7 + 7 \times 0 + 12 = 12$. Put down the 2 and carry forward the 1. Next multiply the hundreds in *B* by the hundreds in *A*, $7 \times 7 + 1 = 50$, or a complete product of 502681.

Working Out a Larger Example

Taking larger numbers, say

$$\begin{array}{r} 3465 \\ 8324 \\ \hline 28842660 \end{array}$$

we proceed as before:

4×5,
$4 \times 6 + 2 \times 5$,
$4 \times 4 + 3 \times 5 + 2 \times 6$,
$4 \times 3 + 8 \times 5 + 2 \times 4 + 3 \times 6$,
$2 \times 3 + 8 \times 6 + 3 \times 4$,
$3 + 3 + 8 \times 4$,
8×3,

setting down in each case the right-hand figure and carrying forward all others and giving 28842660 as the product.

The figures in all cases being simply read off much in the same way as print is read, nothing requires to be remembered beyond the train of figures giving each single figure of the product, which is at once set down, and no other figures except those constituting the answer are put down.

I find in practice that five or six figures in each number are handled quite easily, and in about half the time that is required in the ordinary way of multiplication. I need hardly say that I seldom multiply in any other way.

Wire Fencing as Shelves for Pattern-storage Rooms

The use of wire fencing for pattern-storage shelves was recently called to my attention at the shops of E. E. Bartlett, Boston, Mass. It has many advantages. In this case the central supporting column is used, arms extending each side to carry the shelves, which are made of regular wire fencing such as is often used for office railings.

It is strong, and permits patterns being seen from the under side, so that it saves climbing up to find things. It does not accumulate dust, as board shelves do, and it greatly decreases the danger from fire.

With board shelves, a fire might eat away at the lower shelves and, even if the automatic sprinklers did let go, the water would not get much of a chance at the lower shelves.

The wire shelves are so thoroughly approved by the insurance companies that they are reported to be considering the advisability of insisting on their use in pattern-storage buildings.

New Publications

TASCHENBUCH FUR SEEMASCHINISTEN. By E. Ludwig and E. Linder, with a contribution on Navigation by Prof. P. Vogel. 348 4x6¾-inch-pages, with 329 illustrations in the text, and two colored inserts. R. Oldenbourg, Munich and Berlin. Price, 4.80 marks.

This book, which is a pocket-book in fact as well as in name, is an enlargement of the "Kalender für Seemaschinisten." It is an epitome of a considerable variety of information relating to the design, construction, maintenance and operation of steamships and their machinery. In a book which aims to cover so many subjects within such limits, naturally a very elaborate treatment cannot be expected; however, the amount of information on many of the subjects is quite considerable. It starts with the usual tables and information referring to numbers, trigonometry, mensuration, elementary mechanics and physics, and gives information on strength of materials, steam engines, boilers, screw propellers, and the various kinds of auxiliary machinery on shipboard, the treatment being principally descriptive, with a moderate amount of theory and calculations, and many good clear illustrations. Twelve pages are devoted to the steam turbine; there is a part on the elements of electricity, treating almost entirely of direct current, alternating current getting off with but one and one-half pages. Other parts treat briefly of the construction of ships and of their navigation, and considerable space is given to buoys, signals and maritime laws. The coinage systems of thirty-three countries, and the weights and measures of twenty-four, are tabulated, besides which there is a series of tables of equivalents of metric and English measures, knots and kilometers per hour, and tables of postal and telegraph rates, followed by an alphabetical index. Bearing in mind the limitations of space, this is a very handy reference book, and the printing and binding (barring a *fragmentary* table of contents in the beginning of our copy) are very good.

Personal

Arnold Schreiner, formerly general foreman of the Goodman Manufacturing Company, Chicago, Ill., has accepted a position as superintendent with the Morgan Electric Machine Company, East Chicago, Ind.

Obituary

Sir Benjamin Baker died at London, May 19. Sir Benjamin held a world-wide reputation as an engineer, the two engineering works by which he will best be remembered being the Forth Bridge in Scotland and the Assonan Dam. The Forth Bridge has been declared by some engineers as the greatest construction in the world. It is 2765 yards long and cost $15,000,000. Sir Benjamin was the recipient of many honorary degrees from the leading universities of Great Britain, and was a Fellow of the Royal Society.

Warning!

We wish to again warn our subscribers, and possible subscribers, against a man by the name of J. D. McDonald, or F. B. Kennett, who is fraudulently representing himself as a subscription agent for the AMERICAN MACHINIST. This man was released from the Erie county penitentiary last January and is back at his old tricks. He was last heard from April 22 at Winooski, Vermont. He is small, weighs about 125 pounds, has a very red face, and stooped shoulders. If any of our readers are approached by this man—and will telegraph his whereabouts—we will gladly reimburse them for any expense and will make it worth their while to enable us to land him in prison.

Do not pay money to anyone claiming to represent the AMERICAN MACHINIST or the Hill Publishing Company unless the solicitor can show a credential letter signed by the auditor of this company and limited to three months from date.

Trade Catalogs

The Rahn-Carpenter Co., Cincinnati, O. Catalog of engine, turret, gap and pan Eureka lathes. Illustrated, 6x9 inches, 51 pages, paper.

The General Pneumatic Tool Co., Montour Falls, N. Y. Bulletin No. 58, illustrating and describing electric cranes. 7½x11 inches, 18 pages.

Canadian General Electric Co., Toronto, Ont. Catalog of Tuerk alternating-current ceiling fans. Illustrated, 7½x9 inches, 23 pages, paper.

Fortuna Machine Co., 127 Duane street, New York. Catalog of portable electric tools for drilling, reaming, tapping, grinding and slotting. Illustrated, 7x10 inches, 16 pages, paper.

T. R. Almond Manufacturing Co., 83-85 Washington street, Brooklyn, N. Y. Catalog describing drill chucks, right-angle transmission, turret heads, flexible steel tubing. Illustrated, 5x7½ inches, 29 pages, paper.

Manufacturers

The Youngstown (Ohio) Car Manufacturing Company will build an addition.

The Reading (Penn.) Iron Companya will build a new shop to be one-story, 240x200 feet.

It is reported that the Vincennes (Ind.) Pipe and Casting Company will erect a new plant.

Small Bros., Fall River, Mass., have begun the erection of a new power house to cost $10,000.

The Curtis Saw Manufacturing Company, St. Louis, Mo., is erecting an additional building.

The Union Steam Pump Company, Battle Creek, Mich., will erect a new manufacturing building.

The Capital Traction Company, Washington, D. C., will build an addition to its electric plant.

A $50,000 power plant will be built for the Heath & Milligan Manufacturing Company, Chicago, Ill.

The Peerless Machinery and Supply Company, Wichita, Kan., is erecting a new foundry building.

The Noiseless Car Wheel Company, Detroit, Mich., a new concern, will probably build a steel rolling mill.

The Crawford Locomotive and Car Works, Streator, Ill., propose erecting a smith shop and an erecting shop.

The Barnes Safe and Lock Company, Pittsburg, Pa., has had plans prepared for a new plant near Washington.

The Davenport (Iowa) Locomotive Works is contemplating the erection of a new foundry at a cost of $25,000.

The Baltimore (Md.) Electric Light and Power Company is making plans to greatly increase the capacity of its plant.

Plans are being made to rebuild the plant of the Webster City (Iowa) Steam Radiator Company, recently destroyed by fire.

The plant of the Sterrit-Thomas Foundry Company, Pittsburg, Penn., was destroyed by fire. Loss $50,000. It will be rebuilt.

The Fort Morgan (Colo.) Canning Company has been incorporated with a capital of $45,000. A large canning factory will be erected.

The Page-Storms Drop Forge Company, Chicopee Falls, Mass., is stated to have decided to construct four buildings at Chicopee Junction.

The enameling department of the Amherst (N. S.) Foundry Company was destroyed by fire, causing a loss of about $75,000. It will be rebuilt.

The Atha Tool Works, Newark, N. J., has awarded contract for the construction of a two-story building to be used as a tempering department.

The Wheeling (W. Va.) Flexible Ladder Company is being organized by Captain A. A. Franzheim. A flexible steel ladder will be manufactured.

The Daily Malleable Iron Process Company has been incorporated at St. Louis, Mo., with $80,000 capital stock. Incorporators, M. Morris, F. M. Estes and F. X. Geraghty.

The Atlanta (Ga.) Blow Pipe & Manufacturing Company is being organized to manufacture blow piping systems and other mechanical apparatus. A. J. Leitch, formerly of the Continental Blow Pipe Company, Lexington, N. C., is at the head of the new company.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number.

Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Cox Computers, 53 Ann St., New York.

Caliper catalog free. E. G. Smith Co., Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Slide rule taught, new and easy method. F. F. Nickel, 150 Nassau St., New York.

We desire a few more machines or specialties to manufacture. Address Box 423, Troy, N. Y.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Contract machine work, tools and dies to order. Northwestern Machine Co., Detroit, Michigan.

Special machinery built to order; let us estimate on your work. Capital Foundry and Machine Company, Frankfurt, Ky.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

George W. Nock correspond with F. S. Brundage, 192 Buena Vista Ave., Yonkers, N. Y., has something to your advantage.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted — A responsible concern to place on the market a material for case hardening which revolutionizes present methods. Address "Inventor," AMERICAN MACHINIST.

Arrange with us to do your manufacturing; we build special machinery, special tools, etc. Lewis Blind Stitch Machine Company, 502 North Commercial St., St. Louis, Mo.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Attention, mechanical engineer, representing an American corporation in Germany, Austria etc., like to hear from inventors and others for representation on commission. Address Secretary, P. O. Box 1676, Pittsburg.

Draftsmen, engineers, learn automobile drafting and designing, including the latest European and American practice; the only field not overcrowded; instruction in class room and by correspondence. The New York School of Automobile Engineers. 146 West 56th street.

Advice: mechanical, practical and technical; tell me your needs. I ll tell you the cost; lowest estimates given on fine tools, dies and presses for sheet metal goods production; have you my books? Jos. V. Woodworth, M. E., Arbuckle Building, Brooklyn, N. Y., U. S. A.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Technical graduate, (27), wishes position as assistant superintendent; 5 years' shop and drafting room experience; now hold position as foreman; experience steam engines, mining machinery, jigs, fixtures, etc. Box 27, AMERICAN MACHINIST.

ILLINOIS

Foundry and machine works superintendent, broadly qualified; 35 years' practical and technical experience; proved executive and business ability; seeks responsible position in small or medium sized city; ample references; salary an object. Address "Widower," AMERICAN MACHINIST.

MASSACHUSETTS

Situation as foreman of automatic or hand turret department; 12 years' experience, up-to-date on speeds and feeds and best methods of production. Box 34, AMER. MACHINIST.

Foreman machine pattern maker; thoroughly conversant with intricate work on Pridmore and other machines; designing, drawing and executing, also experienced on hand, vibrator, plate and other forms of metal pattern work; executive ability. Address Box 12. AMERICAN MACHINIST.

Wanted—Position as machine tool and machinery salesman by a practical shop man, expert machinist and toolmaker; 32 years of age, considerable traveling experience; business getting salesmanship guaranteed; east of Buffalo; A-1 references as to ability, integrity, honesty, etc. Address "J. I. J. P.," care AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman; German; 28; technical graduate, experienced on general engineering and construction work desires to change. Box 20, AMERICAN MACHINIST.

Foreman patternmaker wants to change; good reasons; large and varied experience; systematic, progressive and successful; good draftsman; first-class references. Box 24, AMERICAN MACHINIST.

Master mechanic or foreman open for engagement; excellent toolmaker and designer of labor-saving devices; strong executive and good manager of help; A-1 references. Box 977, AMERICAN MACHINIST.

Wanted—Position as factory manager or superintendent by one thoroughly familiar with the design and manufacture of gas, gasolene and producer gas engines and producers; capable of producing the best results. Address "Reliable," AMERICAN MACHINSIT.

Wanted by a first-class and up-to-date machinist, position as assistant superintendent or master mechanic or general foreman; knows how to get best results from high speed steel and from the men now employed; will furnish references; age 40. Box 29, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 14, AMERICAN MACHINIST.

Chief engineer, hydraulic machinery, steam engines, air compressors, condensers. Box 32, AMERICAN MACHINIST.

Valve specialist; eleven years' shop and office experience; present designer in charge, desires change. Box 28, AMER. MACHINIST.

Mechanical draftsman; 3 years' experience also shop experience desires position in New York city or vicinity. Box 13, AM. M.

Practical mechanic—technical and business training, with initiative and capacity, 17 years' executive experience—wants position as factory superintendent. Box 924, AM. M.

Designer of jigs, fixtures and automatic machinery; 30 years of age; technical graduate; 8 years as machinist and 7 years as draftsman wants a change. Address Box 25, AMERICAN MACHINIST.

Position as superintendent or general foreman; experienced on jigs, fixtures, dies, gages, sheet metal and interchangeable work; at present employed; age 34; references given. Address Box 996, AMERICAN MACHINIST.

Wanted—Position as superintendent, manager or purchasing agent by mechanical engineer of 10 years' theoretical and practical experience; good business man, energetic and reliable; holding position at present. Box 961, AMERICAN MACHINIST.

Analytical chemist and practical melter desires change; well up in economical grey iron, bronze and brass foundry practice; rapid and accurate in his analytical methods and knows how to run his department at lowest cost. Box 15, AMERICAN MACHINIST.

Manager, thorough practical and general education, also commercial and 2 years' executive experience as assistant manager, wants position where making the business grow both economical in producing and greater number of sales are considered. Box 7, AMERICAN MACHINIST.

Gas and oil engine expert, at present erection engineer for a large concern earning $100 a month; 10 years' technical and practical experience to all kinds of gas producers and gas engine plants; wish position as designer or foreman in gas engine factory. Address Box 19, AMERICAN MACHINIST.

PENNSYLVANIA

Machine shop foreman desires change; good reference. Box 4, AMERICAN MACHINIST.

Experienced machine designer, accustomed to original work on fine automatic and special machinery, desires situation. Box 30, AM. M.

Expert mechanic, designer and draftsman thoroughly familiar with gearing, power transmission appliances, and automatic machinery for reducing costs; good executive ability; has been superintendent for twelve years; member A. S. M. E.; desires responsible position. Box 26, AMER. MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

A competent traveler in heating and ventilating wanted; give references. Dominion Heating and Ventilating Co., Hespeler, Ont.

CONNECTICUT

Wanted — First-class all-round machinist for new and general repair work. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—A mechanical draftsman, by progressive and up-to-date firm; experience in complicated automatic machinery is essential; in replying, state experience, also give age, nationality and salary expected, together with references. Box 21, AMER. MACH.

Wanted — Experienced chief engineer for electric power plant of 25,000 kw. capacity, operating compound reciprocating engines, steam turbines and gas engines; a permanent and well paid position for competent, responsible man; give detail of experience, present position and salary. E-20 Room 1300, Trude Bldg., Chicago, Ill.

INDIANA

Wanted—Foreman for assembling department of factory manufacturing gasolene engines. Box 16, AMERICAN MACHINIST.

Wanted — Fifteen lathe men and assemblers; new shop, good wages, steady employment. The Western Motor Company, Logansport, Ind.

MASSACHUSETTS

Wanted—One experienced screw machine hand, one general gear cutting man; skilled inspector for machine parts; good working foreman on turret machines. Boston Gear Works, Norfolk Downs, Mass.

Wanted—First-class toolmaker, experienced on punching and forming dies, models, etc.; good opening for right man, in small but growing concern making vending machines and novelties. The Holbrook Mfg. Co., Attleboro, Mass.

Mechanical superintendent for a gear cutting machine shop doing contract work on small and large orders, employing about 75 to 100 men; must be thoroughly capable mechanic; must have originality, and several years' experience in handling men; all applications in writing, stating age, giving references as to ability and character; all communications confidential. Boston Gear Works, Norfolk Downs, Mass.

Superintendent, by growing company building high-grade grinding machinery and employing about 100 hands; must be thoroughly up-to-date in methods, successful in handling men, and able to produce first-class work at reasonable cost; other things equal, preference will be given man with experience on first-class machine tools; write fully as to experience, age, salary expected and present position; confidential if desired. Box 2, AMERICAN MACHINIST.

Wanted—A young man to assist superintendent as shop foreman in a shop employing 150 men manufacturing small tools; must be familiar with manufacturing small tools and capable of handling men and getting out work; we have a desirable position for a competent man; references must be of the best; in answering give age, experience and about what salary would be expected; factory in Massachusetts; answers to this ad will be held strictly confidential. Box 990, AMERICAN MACHINIST.

MICHIGAN

We have a first-class position open for a mechanical draftsman and engineer who is familiar with duplex pump designing and shop practice. Box 991, AMER. MACHINIST.

Wanted—By an established Michigan gasolene engine manufacturer, an experienced draftsman and designer to take full charge of drafting department; applicant must be up-to-date in factory details and a hustler; to such a permanent position is offered; state age, married or single, reference and salary expected; communications treated confidentially. Box 915, AMERICAN MACHINIST.

MISSOURI

Wanted—Six first-class erecting machinists; also 3 gas engine erecting engineers; state references, experience, and salary expected. Box 35, AMERICAN MACHINIST.

Wanted—Machine shop foreman to take charge of 8 to 10 men on general shop repairs; must be advocate of open shop principle; wages $5 per day. Box 17, AMER. M.

Draftsman wanted — Large lead mining company, 65 miles south of St. Louis, Missouri, wants draftsman for mechanical drafting and for making surface and underground maps; must be first-class freehand letterer and neat workman; man with knowledge of plotting and calculating survey field notes preferred; applicants please submit specimens of work and state salary wanted. Box 867, AMERICAN MACHINIST.

NEW JERSEY

Wanted at once, in New Jersey, near New York, competent mechanical draftsmen on

electrical machinery; state salary and experience. Box 980, AMERICAN MACHINIST.

Wanted—Tool die and instrument makers accustomed to accurate complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

NEW YORK

First-class milling machine hand, experienced on tool work; good wages, steady work. R. Hoe & Co., 2 Sheriff St., New York.

Wanted—Good mechanical draftsman; man with experience on valves preferred; apply, stating age, experience and salary expected to Box 999, AMERICAN MACHINIST.

Wanted—Competent machine shop foreman familiar with automobile construction; state age, experience and expectations. Address "Permanent," AMERICAN MACHINIST.

Wanted—Draftsman, experienced in machine equipment; in replying state age, married or single, if now employed, experience and wages expected. Box 22, AMER. MACH.

Patternmakers Wanted—Several first-class pattern makers in machine shop; vicinity Albany, N. Y.; to first-class men good wages and a permanent position guaranteed. Address Box 18, AMERICAN MACHINIST.

Wrenches; practical designer and manager wanted for successful western factory; willing to invest small amount as earnest of good faith; experienced man only; confidential. Box 33, AMERICAN MACHINIST.

Wanted—Manager of a prosperous machine plant established in 1855; man preferred who will take some financial interest in the business; exceptional opportunity for the right man; give experience. Address "Profitable Opportunity," Box 981, AMER. MACHINIST.

Wanted—A first-class mechanical superintendent in a factory for small interchangeable work; a good and permanent position is offered to a man of experience and real ability; an organizer and executive, with a record proving that he can show paying results. Address with full particulars and salary wanted, "Typewriter," AMER. MACH.

Non-union toolmakers accustomed to small accurate work; 42 cents per hour, 54 hours per week; non-union screw machine hands, accustomed to Brown & Sharpe hand and automatic machines, 35c. per hour, 54 hours per week; machinists accustomed to lathe, drill press and bench work, 30c. per hour, 54 hours per week; steady employment guaranteed to first-class men. Apply Jones Speedometer Factory, New Rochelle, New York.

OHIO

Wanted—Good mechanic for erecting electric cranes. Apply, giving experience, Case Mfg. Company, Columbus, Ohio.

Wanted—In middle west, first-class machinists on floor and vise machines; no labor troubles; steady employment at good wages. Box 1, AMERICAN MACHINIST.

Wanted—An all-around machinist to instruct apprentices and handymen on machine tools; good salary; permanent employment and no labor troubles. Address Box 989, AMERICAN MACHINIST.

Head draftsman for a Cincinnati machine tool shop of 100 hands; one with experience on radials and turret machinery preferred; state experience and salary. Address Box 913, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Lathe, planer and boring mill hands. The Blaisdell Machinery Co., Bradford, Pa.

Wanted — Competent pattern maker; one familiar with cabinet making preferred. Box 995, AMERICAN MACHINIST.

Wanted—Experienced draftsmen to work on machinery drawings. Address Ridgway Dynamo and Engine Company, Ridgway, Pa.

Wanted — Blacksmith, experienced on machine shop work, forging, case-hardening and fine tempering. Demorest Mfg. Co., Williamsport, Pa.

On account of increase of plant we want molders, lathe, planer and floor hands; good pay and steady work to good men. Address or apply Ridgway Machine Company, Ridgway, Pa.

Wanted—Foreman, skilled machinist, for small shop building machinery; man who will take interest, finest opportunity for good man. Address, giving full particulars, P. O. Box 1405, Pittsburg.

Wanted—Experienced mechanical and electrical draftsmen on electrical machines and apparatus; only first-class men need apply; state experience and salary expected. Address Box 978, AMERICAN MACHINIST.

Wanted—A man to act as instructor in machine design and mechanical drawing; must be a college graduate with at least three years' practical experience at the board; preferably in the designing of hoisting machinery or machine tools. Box 11, AMER. MACH.

RHODE ISLAND

We are continually adding to our force experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Pierce Mfg. Co., Woonsocket. R. I.

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Wanted—A machinist familiar with repair work on blanking presses and dies. Address "W," AMERICAN MACHINIST.

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To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

FOREIGN

First-class foreman wanted over department of works building power presses; one with American experience preferred; must work to jigs, and be well up in all latest shop practice; state age, wages, experience. J. Rhodes & Sons, Ltd., Wakefield, England.

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For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, Ohio.

Rochester time recorder with two card cabinets and large lot cards; good as new; cost $150. Box No. 31, AMER. MACHNIST.

For Sale—One 72" Wais & Roos power squaring shear; in splendid condition; used but little; first check for $250 takes this machine. Box 23, AMERICAN MACHINIST.

For Sale—Foundry and machine shop in central New York; established trade and bright prospects; only $2500 down to proper party; owner retiring. Box 8, AMER. MACH.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

For Sale—60 h.p. Bigelow return tube boiler; A-1 condition; 80 lb. pressure allowed by Hartford Steam Boiler Insurance Company; just removed to install larger one. West Haven Mfg. Co., New Haven, Conn.

For Sale—All or part interest in a small tool machine business in Western Pennsylvania, now running 15 hands, manufacturing a patented adjustable reamer; more capital required to take care of increasing business. Address "L," 547 Arch St., Meadville, Pa.

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Boring and Turning Mills, Vertical
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes, Tote
Cleveland Wire Spring Co., Cleveland, Ohio.
Lyon Metallic Mfg. Co., Aurora, Ill.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

Brazing
Reinforced Brazing & Machine Co., Pittsburg, Pa.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson Mass.

Bulldozers
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Lyon Metallic Mfg. Co., Aurora, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers
Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Cast Iron Brazing
Reinforced Brazing & Mach. Co., Pittsburg, Pa.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Manufacturers Foundry Co., Waterbury, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel
Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Bartlett, E. E., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co. Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co. Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor, Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Bartlett, E. E., Boston, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Starrett Co., L. S., Athol, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Woods Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Hyde Park, Mass.

Colleges
University of Cincinnati, Cincinnati, O.

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Dixon Crucible Co., Joseph, Jersey City, N. J.

Compound, Slushing
Warren Bros. Co., Boston, Mass.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Blanchard Machine Co., Boston, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

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Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Link-Belt Co., Philadelphia, Pa.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Corundum
See Grinding Wheels

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery
Veeder Mfg. Co., Hartford, Ct.

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We make more of a Specialty of Hand (feed) Millers than any other company in the world.

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Almond Mfg. Co., T. R., Brooklyn, N. Y.
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Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
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Chisholm & Moore Mfg. Co., Cleveland, O.
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Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
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Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
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Maris Bros., Philadelphia, Pa.
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Pawling & Harnischfeger, Milwaukee, Wis.
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United Engineering & Fdry. Co., Pittsburg, Pa.
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Underwood & Co., H. B., Phila., Pa.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.

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Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Inc., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
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Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Cyclometers
Veeder Mfg. Co., Hartford, Ct.

Diamond Tools
American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York City.
Safety Emery Wheel Co., Springfield, Ohio.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edw. R., Chicago, Ill.
Mossberg Wrench Co., Central Falls, R. I.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.

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Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
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Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

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Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Slate Mach. Co., Dwight, Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dallett Co., Thos. H., Phila., Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric
Chicago Pneumatic Tool Co., Chicago, Ill.
Dallett Co., Thos. H., Phila., Pa.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.

Drilling Machines, Portable —*Continued.*
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, Ohio.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Coates Clipper Mfg. Co., Worcester, Mass.

Brown & Sharpe Mfg. Co.

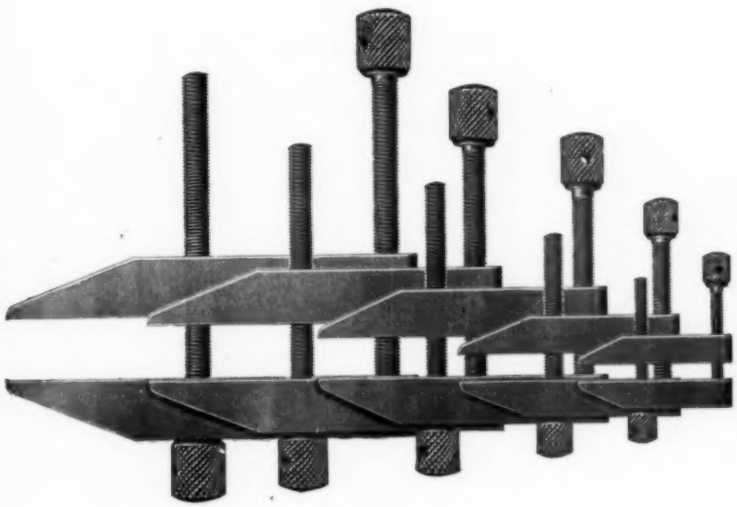
Providence, R. I., U. S. A.

B. & S. Centre Punches

and

Tool Makers' Clamps

Necessary Tools In Every Machinist's Kit.



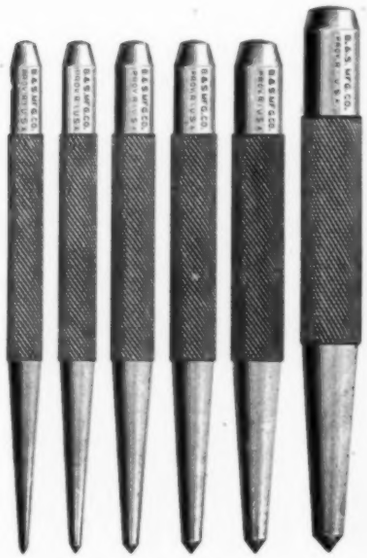
Tool Makers' Clamps.

These Clamps are made of steel, carefully hardened and nicely mottled for a finish. The jaws are rounded on the ends to allow clamping under a shoulder or recess. They fit the jaws sufficiently tight to insure rigidity. The screws are of comparatively fine pitch to give ample leverage.

Machinists' Centre Punches.

These Centre Punches are made with the intention that they shall be a little better than the ordinary requirements of such tools demand.

They are of convenient sizes and knurled on the body to afford a good finger grip. Both ends are tempered and the points carefully ground to an angle. They are about 4 inches in length.



The Small Tool Catalogue, sent to any address, shows these and many other tools.

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Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Lincoln Motor Wks. Co., Cleveland, O.
Ransom Mfg. Co., Oshkosh, Wis.
Roth Bros. Co., Chicago, Il.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels

Emery Wheel Dressers
American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Engineers, Mechanical and Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.

Engines, Gas and Gasolene
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Bormay Engraving Co., New York.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.
Roovers Bros. Machine Works, Brooklyn, N. Y.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Machinery Exchange, Boston, Mass.
Philadelphia Bourse, Phila., Pa.

Expanders, Tube
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Factory Equipment
Lyon Metallic Mfg. Co., Aurora, Ill.

Fans, Electric
Backus Water Motor Co., Newark, N. J.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Backus Water Motor Co., Newark, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.

Fans, Exhaust—*Continued.*
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Fire Brick
McLeod & Henry Co., Troy, N. Y.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Machy. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forging Machinery
The Scranton & Co., New Haven, Conn.

Forgings, Drop
Bethlehem Steel Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic
Bethlehem Steel Co., So. Bethlehem, Pa.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
Baldwin Steel Co., New York.
Bethlehem Steel Co., So. Bethlehem, Pa.
Crescent Forgings Co. Oakmont, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. & Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester, City, N. Y.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co, J., East Boston, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.
Williams Valve Co., D. T., Cincinnati, Ohio.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Hyde Park, Mass.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant-Lees Mach. Co., Cleveland, Ohio.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.